# An exploration of teacher stress when using ICT in technology-rich classrooms

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Submitted for the degree of Doctor of Philosophy

Institute of Education, University of London

2008

# ABSTRACT

This thesis examines stress experienced by teachers whilst using ICT in the classroom. This study approaches this problem from the point of view of a model called the 'Teacher-Technology Environment Interaction Model' of classroom technostress. The study also argues that job complexity is an important concept in understanding environmental stressors.

The thesis reports on an empirical investigation conducted in London, which set out to: record and analyse teachers' technostress, investigate the nature of technostress, and whether forms of job complexity impact on stress. Two different studies were carried out. In the first, a survey about the technology and stress in the classroom was used and responses obtained from 136 teachers. This data was analysed using descriptive and correlational statistics. In the second study, nine teachers participated in a classroom investigation, in which approximately 32 hours of teaching activities were observed. Three types of data were collected in the classroom investigation: observation and videoing of the teachers in the classroom; recordings of their Galvanic Skin Resistance (GSR) taken whilst teaching; and interviews after the session. A thematic analysis was carried out using categories partly derived from theory and partly from the data itself. Additionally, four case studies were constructed to provide more detailed descriptions of technostress.

The main results of this study were to clearly demonstrate the existence of technostress in the classroom; to describe the relationship between age, attitude towards technology, and amount of use and technostress; to describe the chief causes, symptoms, and coping strategies; to relate the causes to forms of complexity; and to provide evidence for the usefulness of the 'Teacher-Technology Environment interaction model of Classroom Technostress'. The thesis concludes by arguing for the value of an approach based on an examination of technostress to complement other approaches for looking at the implementation of technology in the classroom.

# DECLARATION AND WORD COUNT

*I hereby declare that, except where explicit attribution is made, the work presented in this thesis is entirely my own.*

**Word count (exclusive of appendices, list of reference and bibliography): 82,762 words.**

**Signature:** AL-FUDAIL M.A. **25-5-2008**

# ACKNOWLEDGMENTS

**Special thanks to my father and my mother.**

**Many thanks to my family and my friends who have assisted me in preparing my thesis.**

**Thanks to Dr. Carey Jewitt for reviewing this work and to Dr. Don Peterson who supervised the work in 2004-2006.**

**I also have to say that I am very grateful to my supervisor Dr. Harvey Mellar, because without his guidance and support, nothing could have been achieved.**

# CONTENTS

ABSTRACT .......... 2
DECLARATION AND WORD COUNT .......... 3
ACKNOWLEDGMENTS .......... 4
CONTENTS .......... 5
TABLES .......... 9
FIGURES .......... 11
CHAPTER ONE .......... 12
INTRODUCTION .......... 12
CHAPTER TWO .......... 20
STRESS .......... 20
2.1. Introduction .......... 20
2.2. Approaches to thinking about stress .......... 21
*2.2.1. The physiological approach* .......... 21
*2.2.2. The environmental approach* .......... 22
*2.2.3. The psychological approach* .......... 23
*2.2.3.1. Interactional theory* .......... 24
*2.2.3.2. Transactional theory* .......... 25
2.3. Models of stress .......... 27
*2.3.1. Models* .......... 27
*2.3.2. Person-Environment fit model* .......... 28
*2.3.3. The P-E fit model and transactional theory* .......... 31
2.4. Causes, Symptoms, and Coping .......... 32
*2.4.1. Causes of stress* .......... 32
*2.4.2. Symptoms of stress* .......... 34
*2.4.3. Coping with stress* .......... 36
2.5. Stress in Teaching: .......... 38
2.5.1. Causes of stress in teaching .......... 38
2.5.2. Symptoms of stress in teaching .......... 40
2.5.3. Coping with stress in teaching .......... 42
2.6. Conclusion .......... 43
CHAPTER THREE .......... 44
TECHNOLOGY AND STRESS .......... 44
3.1. Introduction .......... 44
3.2. Causes of technostress .......... 45
3.3. Symptoms of technostress .......... 55
3.4. Coping with technostress .......... 57
3.5. The Teacher-Technology Environment Interaction Model .......... 58
3.6. Conclusion .......... 63
CHAPTER FOUR .......... 64
STRESS AND JOB COMPLEXITY .......... 64
4.1. Introduction .......... 64
4.2. Job complexity .......... 65

4.3. Complexity in the classroom ... 71
4.4. Conclusion ... 74

**CHAPTER FIVE** ... 77

**RESEARCH DESIGN** ... 77

5.1. Introduction ... 77
5.2. Preliminary Studies ... 78
5.3. Research Questions ... 86
5.4. Research Methodology and Methods ... 88
5.5. The Survey ... 90
*5.5.1. Elements and Subscales* ... 91
*5.5.2. Validity and Reliability* ... 94
*5.5.3. Sample* ... 100
5.6. The Classroom Investigation ... 101
*5.6.1. Observation* ... 102
*5.6.2. Galvanic Skin Resistance (GSR)* ... 108
*5.6.3. Interview* ... 111
*5.6.4. Reliability and Validity* ... 113
*5.6.5. Sample* ... 113
5.7. Ethical Issues ... 114

**CHAPTER SIX** ... 117

**THE SURVEY** ... 117

6.1. Introduction ... 117
6.2. Descriptive statistics ... 119
*6.2.1. Demographic Data, Attitude Towards, and Use of Technology*.. 119
*6.2.2. Technostress-Causes* ... 121
*6.2.3. Technostress-Symptoms* ... 125
*6.2.4. Age, Gender, Kind of School, Attitude Towards, and Use of Technology* ... 126
*6.2.5. Discussion* ... 129
6.3. Relationship between Demographic Characteristics, Attitude Towards, and Use of Technology and the Causes of Technostress ... 130
*6.3.1. Gender and the Causes of Technostress* ... 130
*6.3.2. Age and the Causes of Technostress* ... 131
*6.3.3. Kind of School and the Causes of Technostress* ... 133
*6.3.4. Attitude Towards and Use of Technology and the Causes of Technostress* ... 134
*6.3.5. Discussion* ... 138
6.4. Relationship between Demographic Characteristics, Attitude Towards, and Use of Technology and the Symptoms of Technostress ... 140
*6.4.1. Gender and the Symptoms of Technostress* ... 140
*6.4.2. Age and the Symptoms of Technostress* ... 140
*6.4.3. Kind of School and the Symptoms of Technostress* ... 142
*6.4.4. Attitude Towards and Use of Technology and the Symptoms of Technostress* ... 143
*6.4.5. Discussion* ... 145
6.5. Responses to the Open-ended Questions ... 147
*6.5.1. Causes of Stress* ... 149
*6.5.2. Complexity* ... 153

*6.5.3. Symptoms of Stress* ..... 154
*6.5.4. Coping* ..... 155
*6.5.5. Discussion* ..... 156
6.6. Conclusion ..... 158

**CHAPTER SEVEN** ..... 161

**THE CLASSROOM INVESTIGATION** ..... 161

7.1. Introduction ..... 161
7.2. The investigation Methods ..... 163
*7.2.1. GSR Readings* ..... 164
*7.2.2. Interview* ..... 168
7.3. Analysis ..... 171
*7.3.1. The Nodes* ..... 173
*7.3.2. Causes* ..... 174
*7.3.3. Complexity* ..... 180
*7.3.4. Symptoms* ..... 182
*7.3.5. Coping* ..... 183
*7.3.6. No Technostress* ..... 184
*7.3.7. Discussion* ..... 186
7.4. Case Studies ..... 187
*7.4.1. Case Study of Teacher S* ..... 187
*7.4.2. Case Study of Teacher P* ..... 190
*7.4.3. Case Study of Teacher ST* ..... 192
*7.4.4. Case Study of Teacher R* ..... 195
*7.4.5. Discussion* ..... 197
7.5. The main results ..... 199

**CHAPTER EIGHT** ..... 202

**DISCUSSION** ..... 202

8.1. Introduction ..... 202
8.2. Technostress ..... 202
*8.2.1. Introduction* ..... 202
*8.2.2. Technostress in the Literature* ..... 202
*8.2.3. Existence of Technostress* ..... 204
8.3. Causes ..... 208
*8.3.1. Introduction* ..... 208
*8.3.2. Technostressors in the Literature* ..... 208
*8.3.3. Causes of Technostress* ..... 209
*8.3.3.1. Job characteristics* ..... 210
*8.3.3.2. Organisational factors* ..... 214
*8.3.4. Discussion* ..... 216
8.4. Complexity ..... 218
*8.4.1. Introduction* ..... 218
*8.4.2. Complexity in the Literature* ..... 221
*8.4.3. Workload* ..... 221
*8.4.4. Unpredictability* ..... 223
*8.4.5. Simultaneity* ..... 224
*8.4.6. Discussion* ..... 225
8.5. Symptoms ..... 227
*8.5.1. Introduction* ..... 227

*8.5.2. Technostress Symptoms in the Literature* .......... 227
*8.5.3. Technostress Symptoms* .......... 227
8.6. Coping .......... 229
*8.6.1. Introduction* .......... 229
*8.6.2. Technostress Coping Strategies in the Literature* .......... 229
*8.6.3. Technostress Coping Strategies* .......... 230
8.7. The T-TE model .......... 231
*8.7.1. Introduction* .......... 231
*8.7.2. The relationship between the use of technology and technostress* .......... 231
*8.7.3. The adequacy of the T-TE model* .......... 234
8.8. Contributions of the study .......... 241
8.9. Limitations of the study .......... 243
**CHAPTER NINE** .......... 247
**RECOMMENDATIONS AND CONCLUSIONS** .......... 247
9.1. Introduction .......... 247
9.2. Implications and recommendations for reducing technostress .......... 250
*9.2.1. Demand-Ability fit* .......... 250
*9.2.2. Need-Supply fit* .......... 253
9.3. Future research .......... 254
9.4. Conclusions .......... 255
**BIBLIOGRAPHY** .......... 257
**APPENDIXES** .......... 279

# Tables

Table 1: Causes of technostress as reported in the literature ........................ 47
Table 2: Symptoms experienced by the users of technology.......................... 81
Table 3: Cognitive symptoms of mental fatigue and age of the respondents 82
Table 4: Complexity of life increases because of technology ......................... 82
Table 5: New technological devices are more complicated than old tools..... 83
Table 6: The expectations of students about the future of technology, sample of (104) students.......................................................................................... 83
Table 7: Research questions and methods...................................................... 90
Table 8: Elements and subscales of the survey................................................ 94
Table 9: Reliability of the subscales................................................................. 97
Table 10: Correlation matrix of the subscales (119 teachers) ......................... 99
Table 11: Correlation matrix of the subscales (97 teachers)........................... 99
Table 12: Excluded Cases ............................................................................... 101
Table 13: Teachers who participated in the classroom investigation ........... 114
Table 14: Age and Gender.............................................................................. 119
Table 15: Type of school ................................................................................ 119
Table 16: Attitude towards technology.......................................................... 119
Table 17: Amount of use of technology ........................................................ 119
Table 18: Experience of technostress............................................................. 120
Table 19: Causes of technostress (n=97) ....................................................... 121
Table 20: Causes of technostress (n=119)..................................................... 122
Table 21: Correlation Matrix (causes)........................................................... 124
Table 22: Symptoms of technostress (n=97).................................................. 125
Table 23: Symptoms of technostress (n=119)................................................ 126
Table 24: Age and amount of time using technology everyday for educational purposes ......................................................................................................... 127
Table 25: Age and attitude towards technology ............................................ 127
Table 26: Gender and attitude towards technology........................................ 127
Table 27: Gender and amount of time using technology everyday for educational purposes..................................................................................... 128
Table 28: Kind of school and attitude towards technology ........................... 128
Table 29: Kind of school and amount of time using technology everyday for educational purposes..................................................................................... 128
Table 30: Attitude towards technology and amount of time using technology everyday for educational purposes................................................................ 129
Table 31: Gender and the causes of technostress ........................................... 131
Table 32: Too much change and gender......................................................... 131
Table 33: Age and the causes of technostress ................................................ 132
Table 34: New learning required, more demands, too much change, technology physical problems, security issues and age ............................... 132
Table 35: Kind of school (primary and secondary) and the causes of technostress .................................................................................................. 133
Table 36: Attitudes and the causes of technostress........................................ 134
Table 37: More work required, new learning required, more demands, too much change and attitude towards technology ............................................. 135
Table 38: Attitude towards technology and causes of technostress reported as 'high' ........................................................................................................ 136

Table 39: The reported use of technology for education everyday and causes of technostress ... 137
Table 40: Security issues and amount of time using technology ... 137
Table 41: The reported use of technology and the reported causes of technostress as 'high' ... 138
Table 42: Gender, age, attitude, amount of use and the reported causes as 'high' or 'medium' ... 139
Table 43: Gender and the symptoms of technostress ... 140
Table 44: Age and the symptoms of technostress ... 141
Table 45: Muscle tension, mental fatigue, bad temper, and insomnia and age ... 141
Table 46: Kind of school (secondary and primary) and the symptoms of technostress ... 142
Table 47: Attitudes and the symptoms of technostress ... 143
Table 48: Headaches, anxiety, and avoidance and attitude towards technology ... 143
Table 49: Use of technology for education everyday and symptoms ... 144
Table 50: Mental fatigue and use of technology for education everyday ... 144
Table 51: The reported use of technology for education everyday and symptoms of technostress ... 145
Table 52: Attitude and the most frequently reported symptoms of technostress ... 146
Table 53: Causes (open-ended) ... 150
Table 54: Complexity (open-ended) ... 154
Table 55: Complexity and causes (open-ended) ... 154
Table 56: Symptoms (open-ended) ... 155
Table 57: Coping (open-ended) ... 156
Table 58: Time and GSR (Teacher S) ... 165
Table 59: Causes node (classroom investigation) ... 175
Table 60: Complexity (classroom investigation) ... 180
Table 61: Complexity and causes (classroom investigation) ... 182
Table 62: Symptoms (classroom investigation) ... 183
Table 63: Coping (classroom investigation) ... 184
Table 64: No Technostress node (classroom investigation) ... 185
Table 65: Complexity and causes (open-ended questions in the survey) ... 219
Table 66: Complexity and causes (classroom investigation) ... 219
Table 67: The two forms of the T-TE model and the technostress ... 236

# Figures

Figure 1: A model of stress as person-environment fit .... 29
Figure 2: Teacher-Technology Environment Interaction Model of classroom technostress .... 61
Figure 3: Responses to open-ended questions (tree nodes) .... 149
Figure 4: The GSR readings for Teacher S when there were problems with the voting instruments .... 166
Figure 5: The GSR readings for Teacher S when she was teaching about assessment .... 166
Figure 6: The GSR readings for Teacher S when there was a problem with the printer .... 166
Figure 7: Sample of passages coded at three child nodes .... 172
Figure 8: Classroom investigation (tree nodes) .... 174

# Chapter One

## INTRODUCTION

After completing my Masters degree at World Maritime University (WMU) in Sweden in 1995-96 on the integration of technology in the classroom, I returned to Saudi Arabia and attempted to apply what I had learned about ICT in education. I found that teachers and trainers were embarrassed by the idea of using and applying technology for teaching in all our training and education institutions. So we started to study how we could achieve positive change in this direction. We were supported by authorised professionals from the General Department of Training in the Saudi Arabia Coast Guard. Over six years of trials and many studies we noted many complaints by teachers applying technology in their classrooms. At one point, we were using specific software provided and recommended by the International Maritime Organization (IMO), but for some teachers it didn't help much. Their complaints were not only about the software but arose about other aspects of the technology. For me, this was disappointing. In addition, those who supported us and were enthusiastic about the idea appeared upset because they did not expect teachers to complain about it, and they came to be concerned that such complaints might affect teachers' well-being more generally.

Why do some teachers complain about technology in their classrooms? Does technology make teaching more difficult and stressful for teachers? Is there a mismatch between the technology and the teachers' requirements? Does it bring huge changes to teaching? Does it make the classroom environment more complicated? Or do the complaints arise more from the teachers' attitudes, skills, abilities, and experiences? Do these complaints reflect that we do not know how to deal and cope with the difficulties that technology poses to us? What are the main reasons? In short, does technology make teachers happy in their classrooms or does it cause stress for them?

These questions and many others come to mind when I try to evaluate my own teaching environment and also when some of my colleagues complain about their use of technology or ask for assistance. If the use of technology was easy and helpful in teaching, why do some teachers complain about it? Maybe some teachers (including myself) do not like to change our old methods of teaching and therefore are unenthusiastic about new technologies and approaches. Maybe we are not paying much attention or not giving enough effort to learn new skills, and therefore we complain and put the blame on the technology.

For my PhD thesis, I therefore decided to study the impact of technology, investigating the reasons that cause some teachers to experience frustration and unhappiness when they use technology in their teaching, and so to complain about technology.

During the beginning of my study at the Institute of Education, I discussed this issue with some PhD students and teachers in the UK. They told me about their experiences and feelings towards the technology, which were similar to what I had experienced before and observed with some other teachers in my home country. One day, I was in a Research Methodology session at IOE, when the tutor failed to access his account and therefore could not present his lecture. The tutor later confessed that "Although teaching itself is stressful, using technology makes me more stressed". Therefore, I realized that it was not an issue that affected only me and some of my colleagues, but was something experienced by many others, including professionals in the UK. So it seemed possible that this was a common phenomenon meriting further investigation. However, as some teachers complain of frustrations, others feel unhappy, while some get angry. I recognised that such psychological and behavioural symptoms might be explained and attributed to the **stress** experienced by the teachers. In the well known definition of teacher stress, Kyriacou and Sutchliffe (1978a) stated that 'teacher stress' is "the experience by a teacher of unpleasant negative emotions, such as anger, frustration, anxiety, depression and nervousness, resulting from some aspect of their work as a teacher" (Kyriacou, 2000, p: 3). Accordingly, I wished to ask whether there is any association between the use of the technology and stress?

Complaints and dissatisfaction reflect the relationship between the employees and their work environment. The relationship between the person and the environment has been conceptualised in different ways by a range of models. Among them is the

Person-Environment fit model (see, e.g., Al-Mohannadi, 2004). Some studies have discussed teachers' responses to the misfit between them and their environment, in terms of the concept of ***stress***, noticing psychological, physiological, and behavioural symptoms commonly associated with stress. So, this study investigates the existence of a relationship between technology use and teacher stress, the key factors that influence teachers' stress in a technology-rich classroom environment, and the nature of any relationship between technology use and teacher stress in the technology rich classroom. Investigating the factors that cause stress to teachers when they use technology in their classrooms might help to find solutions that would reduce or alleviate this kind of stress.

There have been many studies of teachers' use of ICT. Evans-Andris (1995) says that teachers - with regard to the use of computers - avoid, integrate or technically specialise. Other researchers (e.g. Rosen and Weil, 1995; Hadley and Sheingold, 1993; Winnans and Browen, 1992; Dupagne and Krendl, 1992; and Mumtaz, 2000b) give reasons for teachers not using technology in schools namely: lack of time, experience, lack of support, lack of availability of computers, lack of technology specialists to teach students computer skills, lack of financial support and lack of help supervising students when using technology. There are many studies reporting on the advantages of integrating technology. The factor of stress is rarely considered in these studies. A number of studies have argued that new technology makes life in our society more complicated than before and causes stress (Weil and Rosen 1997). Education is no exception to this, and workers in educational institutions may well experience stress. This appears to be an under-researched area, and so this study sets out to examine this issue, and in particular in relation to teachers in the classroom.

One of the potential significances of the present study is to make teachers aware of this kind of stress. Some authors argue that as individuals do not know about stress they should get to know more in order to be better able to deal with it (Dunham, 1992). Although some teachers complain about stress and teaching problems and they try to cope with it, others do not complain about stress because they associate it with weakness, incompetence, failure and think of it as a sign of poor professional performance (see, for example, Dunham, 1992). Some attribute this lack of complaint as a result of the stigma of stress (see, for example, Younghusband, et al.,

2003) or in the case of the use of technology, they (in addition to the beliefs above) fear they might be described as old-fashioned and less-qualified than other people more oriented to modern life. Cox (1977 cited in Johnstone, 1989, p. 6) asks "Can teachers be stressed if they do not perceive themselves as being stressed?" This thesis addresses the issue of teachers and technology-related stress, or 'technostress', and will hopefully contribute to a wider understanding of the issue and enable teachers and their employers to take appropriate actions.

This study will also look at the causes of technostress. This could be achieved by looking at the nature of the classroom environment and the nature of the work within this environment. Classroom environments are different and complicated as objects of study because of the number, the pace, and unexpected character of events in the classroom. The classroom "is...the most complex and least understood situation on the face of the planet" (Watkins, 2000, p. 2). Many studies have been conducted to investigate the classroom environment, assuming that a good environment would not only lead to effective teaching and learning, but it will help to reduce the probability of stress (see, for example, Al-Mohannadi, 2004). In 1968, Jackson wrote about 'life in classrooms'. His work was of importance to researchers who carried out studies in managing the classroom, examining complexity in the classroom, and exploring teachers' strategies. Such studies have related the complexity of classroom environments to the stress experienced by teachers. More recently some researchers reported that integrating technology in classroom environments has increased the level of complexity for some teachers and increased their workload (see, for example, Sinclair 2003; Rasmussen and Mathiasen, 2004; Phelps, et al., 2005). They have argued that this increase in the complexity of the classroom may not only affect the teaching and learning, it might also have an effect on teachers' well-being (see, for example, Rasmussen and Mathiasen, 2004). Accordingly, the complexity arising from the use of technology in classroom environment might be related to cause of stress, and needs to be investigated.

Another significant point of this study is to show how teachers cope with this kind of stress, and it will attempt to identify strategies that might help to combat such stress. Stress has often been the cause of difficulties for the teaching profession, as Milstein and Golaszewski (1985) commented, "The end result is that many talented men and women with high expectations of achievement are dispirited and disillusioned. Some leave the profession, others stay, but are plagued by a multitude of physical, emotional and behavioural stress-related manifestations" (p. 389). Some studies have argued that stress associated with the use of technology and dissatisfaction with technology is a significant factor in determining the success of the use of technology in education (Lee, et al., 2002). It is hoped that the results of the present study will be of benefit to teachers and students, and to educators and educational program providers trying to improve the integration of technology in education.

**The main aims of the research are as follows:**

Aim 1: ***To determine whether there is a relationship between technology use and teacher stress in the technology rich classroom.***

Aim 2: ***To identify the key factors that influence teachers' stress in the technology-rich classroom.***

Aim 3: ***To identify the nature of the relationship between technology use and teacher stress in the technology-rich classroom, and determine to what degree the Teacher-Technology Environment Interaction Model of classroom technostress provides an adequate model of this relationship***

The literature review and pilot studies helped to refine these aims, so that by Chapter 5, the researcher can present specific research questions arising from these aims:

Aim 1: ***To determine whether there is a relationship between technology use and teacher stress in the technology rich classroom.***

Is there a relationship between technology use and teacher stress in the technology-rich classroom?

Does increased use of technology result in increased stress?

Is there an association between the attitude towards technology and the individual's report of experiencing technostress?

Is this experience of technostress associated with age, gender, type of school, attitude, and amount of use of technology?

Aim 2: ***To identify the key factors that influence teachers' stress in the technology-rich classroom.***

What are the main stressors associated with technostress?

What are the chief symptoms of technostress?

What are the coping strategies that teachers use to deal with technostress?

Aim 3: ***To identify the nature of the relationship between technology use and teacher stress in the technology-rich classroom, and determine to what degree the Teacher-Technology Environment Interaction Model of classroom technostress provides an adequate model of this relationship***

What is the nature of the relationship between technology use and technostress? Is this a relationship mediated by the personal understandings of the teacher, and if so, in what ways?

Does the T-Te model provide an adequate model of this interaction?

Since the topic is relatively unexplored, more emphasis is given to qualitative research rather than quantitative research in order to delineate the main variables involved rather than to establishing statistical correlations between factors (though I do also do that to some degree as well). Quotations drawn directly from participants are more likely to throw more light on the issues than mere statistics alone (following the recommendations of, for example, Creswell, 2003).

This study, which was conducted with teachers in the UK, used a combination of methods, bringing together both qualitative and quantitative data, in order to better understand the factors that might be associated with teachers' stress when they use technology in the classroom. In the study, a questionnaire was used to find whether teachers' stress was associated with their use of technology in technology-rich classrooms and whether factors such as teacher's attitude, age, gender, time of use, and kind of school were associated with teacher stress. Causes, symptoms experienced by the teacher and his/her coping strategies in the classrooms were explored using a combination of three data sets obtained from: a) direct observation with video-logging of the teachers while they teach and at the same time b) recording of their Galvanic Skin Resistance (GSR) and c) interviewing them after the teaching session.

This thesis consists of nine chapters. Chapter One introduces the main purpose of the thesis, namely investigating teacher stress when using technology in the classroom. The background and the expectations of the study as well as the methodology are introduced in this chapter.

Chapter Two discusses the literature on the concept of stress, and the nature and existence of stress in human life. The main approaches to conceptualising stress are reviewed. This leads to consideration of theories of stress that might help to investigate its occurrence in classrooms, particularly when teachers use technology. The Person-Environment fit model is discussed and arguments presented as to its suitability for this study. The chapter also discusses the causes of stress in the workplace and in teaching, and some well-known studies of teacher stress are highlighted. Demonstrating the existence and nature of stress is the main objective of this chapter. The chapter also reviews the methods that have been used to measure stress generally and particularly in teaching.

Chapter Three discusses technostress as an aspect of stress. It defines the concept of technostress and examines studies that have investigated technostress. It examines claimed explanations as to why technology might cause stress, and what are the claimed causes of technostress both in general and in education. This chapter discusses the results of studies that have addressed the problem of technostress in workplace, and examines the extent to which this issue has been investigated in classrooms. The main objective of the chapter is to discuss the existence of technostress in human life generally, as indicator of causes that might be found in classroom. After discussing stress in Chapter Two, and technology as a factor that might be associated with stress in the main part of Chapter Three, Chapter Three concludes with a description of the model designed in this thesis to investigate teacher stress in the technological classroom environment.

Chapter Four discusses the concept of complexity as a wider concept that covers many factors that cause stress when technology is used. It argues that complexity is an important factor in this study. A definition of complexity is presented, and some earlier studies that have investigated complexity in the workplace are described. There is also a discussion of complexity and its association to technostress. This chapter also discusses unpredictability, workload, and simultaneity as forms of complexity.

Chapter Five describes the methodology that is used in this study. It starts by discussing the pilot studies conducted in 2003-04. Then it describes and justifies the chosen methodology of this study. The methods (i.e., questionnaire, observation, GSR, and interview) are described. Research questions, sampling, and the validity and the reliability of the research instruments are discussed.

Chapter Six discusses the construction of the survey, and then presents the findings from this aspect of the work. The chapter explains how the data was analysed, and gives tables presenting descriptive statistics and some measures of association between variables. It also discusses the analysis of the responses to the open-ended questions. The main aim of this chapter is to examine the evidence from the survey in order to throw light on whether or not technostress exists in classroom.

Chapter Seven presents the main findings from the classroom investigation that were accomplished through observations, GSR, and interviews. This chapter discusses the analysis of the data captured using the three methods. Four case studies of individual teachers are presented in order to throw further light on the nature of technostress in the classroom.

Chapter Eight looks at the empirical findings in relation to the main research questions. It reviews the main findings from the survey and the classroom investigation in terms of the literature. This chapter looks at the findings in the light of the Teacher-Technology Environment Interaction Model. The chapter also explains the main findings in relation to the main types of complexity. Finally, there is a discussion of the contributions and the limitations of the study.

Chapter Nine presents some recommendations relating to the management of stress in the technological classroom. This chapter also includes some suggestions for future studies, and the conclusion of the thesis.

# Chapter Two

## STRESS

In order to look more closely at the issue of stress possibly associated with the use of technology in the classrooms, it is necessary to look more closely at the concept of stress and discuss how this term will be used in this study. This chapter will discuss the concept of stress and will start to derive the theoretical framework of the present study.

### *2.1. Introduction*

There are many definitions of stress. Many terms are used to describe the emotions, reactions, and feelings of individuals when trying to deal with a threat or a problem – terms such as anxiety, burnout, stress, depression, pressure, frustration and breakdown (see, for example, Staal, 2004). These concepts have often been used as synonyms for each other, so sometimes authors conflate studies originally about different concepts with one another. Some researchers in the field have sought to give definitions to these terms in order to clarify the differences between them (see, for example, Gray and Freeman, 1988).

What distinguishes stress from emotion in general? Lazarus argues that stress connotes "a particular aspect of emotion, the negative disturbing aspect as in fear, anxiety, anger, and depression" and that "stress conveys the idea that the person or animal is beset by powerful pressures which greatly tax the adaptive resources of the biological or psychological system. This emphasis is not inherent in the term 'emotion' as it is in 'stress'" (Lazarus, 1966, p. 10).

This chapter consists of five sections. The first section will explain the main approaches to thinking about stress. The second section will discuss the stress models, the third section will be about the main elements of stress: cause; symptoms; and coping strategies. The fourth section will discuss the stress in teaching. Finally there will be a conclusion.

The following section will examine the major theoretical perspectives on stress and present an argument about the appropriate approach for this study.

## 2.2. Approaches to thinking about stress

Reviews of the investigation of stress (e.g., Cooper et al., 2001; Jovanovic, et al., 2006) divide existing approaches towards stress into three groups: (a) Physiological approaches; (b) Environmental approaches; and (c) Psychological approaches, each of which will be discussed below.

### 2.2.1. The physiological approach

The physiological approach focuses on psycho-physiological changes (Cox, 1987) and defines stress as the physiological responses of a person to a wide range of noxious stimuli (stressors) (Chin-Yi, 2003). This approach is referred to by some researchers as the medical model (McNamara, 2000). It does not look at the reason for the symptoms but simply seeks to identify and treat them (Cooper, et al., 2001). This approach is based on the work of Selye who viewed stress as a "non-specific response of the body to any demand made upon it" (Sime, 2007). Selye's work in turn was influenced by Cannon's work (1909), who "focused on the role of the sympathetic nervous system in adaptation, and coined the terms 'fight-or-flight responses' and 'homeostasis'" (Thomas and Neylan, 1998). Selye, who made the term *stress* popular in medicine (Posen, 2000), discovered in 1930 that the majority of patients while they were sick experienced the same symptoms, therefore he stated that "symptoms must be part of a syndrome of just being sick" (Doublet, 2000, p. 103). He later named this as the General Adaptation Syndrome (G.A.S) (Posen, 2000). Selye's General Adaptation Syndrome theory has three stages (this account is drawn from Sutherland and Cooper, 1990): (1) the alarm or emergency reaction similar to the 'fight or flight' response, which is considered as the immediate psycho-physiological response, and within this stage the defence mechanisms of the body are activated; (2) 'resistance' in which the return to equilibrium and/or adaptation response replaces the first stage, it takes place if the stressor is prolonged, during this stage the body struggles to adapt and might experience limited rest/sleep; (3) 'exhaustion' where the body's energy needed for adaptation becomes depleted, therefore the body systems crash, and "fatigue, errors, irritability, vulnerable to illness (colds, flu, acne)" (Sime, 2007) might occur.

It has been argued that this approach does not provide a satisfactory definition of stress because there are differences between specific and non-specific responses of the body to any stressor, i.e. a stimulus won't have the same response from the same body every time (see, for example, Lazarus, 1966). Also, is the same response or the amount of the response repeated with the same stimulus? Some individuals become familiar with some threats so their response varies with the time and familiarity (Sutherland and Cooper, 1990). Some authors related this variation to other factors such as experience, circumstance, and emotion. This approach ignores individual differences; psychological and organisational variables; and the relationship between the individual and his/her environment (see, for example, Grimshaw, 1999, p. 34-35). The physiological approach is therefore particularly poor at looking at the influence of environment and psychological variables, and these are the sorts of things the researcher wants to look at, so it is not a good approach for this study.

### *2.2.2. The environmental approach*

The environmental (engineering) approach views stress as "pressure exerted by the environment" (Kyriacou and Suctcliffe, 1978a, p. 1). This approach deals with the external demands caused by the environment that are placed on the person. It is known by some researchers as the stimulus model (Cox, 1987), or the environmental model (McNamara, 2000). The environmental approach has been particularly used in studies investigating the causes of stress in the work environment and those due to the rapid changes in workplaces.

Copper, et al. (2001) argued that the issue of 'individual differences' is the major weakness of this approach because what causes stress to one person might not cause stress to another, and "no objective criterion is sufficient to describe a situation as stressful and that only the person experiencing the event can do this" (Sutherland and Cooper 1990, p. 17). The interaction between the environment and individual is ignored in this approach.

This approach has been used in a range of studies, including a number looking at identified stressors, such as life events or daily hassles, and the individual's health. An early scale produced by Holmes and Rahe in 1967 to investigate the relationship between life events and ill health, the 'Social Readjustment Rating Scale' (SRRS), attracted much attention. This scale was used to measure the number of changes accrued to a person in a given period. The findings illustrated the positive correlation between life changes (positive or negative) and physical illness (Heylighen, 2000). Critics identify a limitation in the scale (and its revised form by Holmes in 1979) in that it does not cover life-changing events such as industrialization and new technology (Sutherland and Cooper, 1990, p. 17), nor does it consider the circumstances of the individual.

Other research has tried to measure daily hassles and uplifts (McNamara, 2000), or daily difficulties (such as the assessment of daily experience (ADE) by Stone and Neale, 1982). These kinds of scales have been criticized because they were readily "confounded with self-report measures of psychological distress" (Jones and Bright, 2001, p. 26). However the very idea of such scales has been questioned and it has been argued that it is better to focus on single factors associated with stress. Costa and McCrae (1990) argued that lists of events "do pose methodological problems, however, so students of stress outcomes are probably better advised to focus on a single fateful event, such as bereavement or technological disaster" (Costa and McCrae, 1990, p. 23).

### *2.2.3. The psychological approach*

As noted earlier, a major issue with both the physiological and environmental approaches is that neither of them considers individual differences such as personality attributes, expectations, values, or goals. The physiological approach does not tell us much about the nature of stress or where it occurs; nor does it include a consideration of factors such as social support, control, and appraisal, which are mediating influences. The environmental approach does not tell us much about the nature of the stressor and factors such as frequency, duration, demand, intensity, and severity (Cooper, et al., 2001).

The psychological approach defines stress as the interaction between the person and the environment (Cooper, et al., 2001; Lazarus, 2006, Jovanovic et al., 2006). Two theories have emerged from the psychological approach - namely the interactional theory of stress and the transactional theory of stress - will be discussed below.

### *2.2.3.1. Interactional theory*

Some authors use the term 'interaction' to refer to the relationship between elements, they consider that "elements [person and environment] are primary, and can be described and located independently of one another. The task for the scientist, then, is to inquire into the derived relations between such elements, that is, into the manner in which the elements act upon one another" (Riegel and Meacham, 1978, p. 24). The interactional theory simply describes the relationship between the individual and his environment, by looking at the statistical interaction between the stressor (cause by the environment) and response (by individual); it is an essentially static, cause and effect formulation, (Lazarus and Launier, 1978, p. 289-293).

In occupational stress, this theory "focuses on the structural features of the person's interaction with their work environment" (Jovanovic, et al., 2006, p. 166). One example of the use of this theory is in thinking about workplace stress in the Job Demands-Control (JD-C) model. Pugliesi (1999) used this model describing the conditions that influence job stress as the level of demand, degree of control, or decision latitude that workers exercise. He found empirical evidence that the effective responses to work and well-being are affected by job demands and control (or autonomy) (Pugliesi, 1999, p. 99). A model proposed by Sutton and Kahn (1986) known as 'General work stress health model' postulates that the perception of stress is affected by the objective work conditions, hypothesizing that both the internal characteristics (i.e., personal characteristics) and the external characteristic (i.e., situational characteristics) have interactive or moderating effects in addition to the direct effects between them (Tetrick and LaRocoo, 1987, p. 538).

The interactional theory has been criticised for putting emphasis on the elements of the interaction rather than on the transaction itself. Lazarus and Folkman, (1984) pointed to the limitations of this theory and argued that it is unidirectional, statistical and antecedent-consequent theory; they emphasised the importance of the transactional theory, which will be explained below.

### *2.2.3.2. Transactional theory*

In the transactional theory, activity is "assumed as primary, and elements [person and environment], as derived and secondary within the system" (Riegel and Meacham, 1978, p. 24). This approach considers the cognitive processes and emotional coping in the interaction between the individual and the environment (Jovanovic, et al., 2006). Lazarus and Folkman, (1984) state that one of "the distinguishing feature of transactional thought, the one that gives the term transaction a quality missing in the concept of interaction, is that transaction implies a newly created level of abstraction in which the separate person and environment elements are joined together to form a new relational meaning, In interaction, particularly in statistical analyses that fractionate the variance of a cause-and-effect sequence, the interacting variables retain their separate identities" (Lazarus and Folkman, 1984, p. 294). Individual variables and environmental variables were emphasized by Lazarus, (1966) as important factors that enriched the existing studies on stress. Environmental factors that influence stress are demands, constraints, opportunities and culture; whereas personal factors include goals and goal hierarchies, beliefs about self and world, personal resources such as intelligence, money, social skills, education, supportive family and friends, attractiveness, health and energy, sanguinity (Lazarus, 2006, pp. 61-72).

The difference in the work of Lazarus from earlier work is that he views stress as "a complex, multivariate process because it has different influences such as environment, personality factors, ways of appraisal, ways of coping and changes over time" (Jones, and Bright, 2001, p. 20). In transactional theory, stressful experiences are interpreted as transactions between the individual and the environment; these transactions depend on the impact of the stressor, but are mediated through two main processes, namely the appraisals process and the coping process. The individual evaluates the situation and realises that "something is at stake" (primary appraisal), then he/she appraises whether it is harm (damage that has already occurred e.g., loss of job), threat (harm that has not yet happened, the focus is on protecting against harm) for his/her well-being, or challenge (a condition of high demand in which the emphasis is on mastering the demand and on the positive outcome possibilities)[1]. The second appraisal process starts when the individual begins to deal with the threat or harm by identifying the concerns and the availability of the coping resources, their applicability and chances of success. These two appraisals (the primary and the secondary appraisal) interact with each other and shape the degree of stress, the strength and the quality of the emotional response. Sometimes due to new information from the environment or/and the person, or if the event was experienced before, then 'reappraising' occurs. These two processes of the appraisals prepare the person for the coping process (Lazarus, 1966; Lazarus and Folkman, 1984; Lazarus, 1991; Lazarus, 1995; McNamara, 2000; and Lazarus, 2006).

Accordingly, this theory will be used in this study, because it is considered as a theory that overcomes some of the limitations found in the environmental, physiological, and interactional theories. The environmental and the physiological theories failed to consider the relationship between the individual and his/her environment. Whereas the interactional theory was unidirectional, statistical and antecedent-consequent theory as argued by Lazarus and Folkman (1984)

One of the models which applied this theory was the 'effort-reward imbalance' model by Siegrist (1996), which suggests that high effort and low reward combination might result in threat to individual's self-esteem and self-efficacy and is likely to cause health problems (Koslowsky, 1998; Owens, 2005). Many researchers have used the transactional theory because of the way in which it throws light on the likelihood of psychological stress (see, for example, Ross and Altmaier, 1993; Perrewe and Zellars 1999; Matthews, 2000; Mughal, 2003).

There are critiques of the transactional theory. Owens (2005) stated that the transactional theory's "impact has been much less marked in occupational field, and that this may be because the main concern of occupational psychologists has been to identify common, measurable work factors that can be modified to improve the general well-being of the workers" (p. 60). A specific area of dispute concerns

[1] This account is drawn from Lazarus, 1995, p. 6.

awareness. Lazarus and Folkman (1984) emphasised the importance of appraisal in the stress process, where the individual evaluates the situation as a threat or not. Beehr and Franz (1987) argued that some people might be aware of the stressor and strain, whereas others might not be aware of one or both of them and some might not be aware of the relationship between them. They argued that Lazarus stresses the need for awareness because of his interest in the coping process, as a person might not engage in a coping process unless he/she is aware of the problem (Beehr and Franz, 1987). Brief and George (1995) emphasise the importance of discovering the working conditions that are likely to adversely affect workers. In the same vein Harris (1995) states that "the influence of the work situation may change the relationship of the coping concept from a mediator to a moderator and, thus, significantly alter the transaction model" (Harris 1995, p. 27).

## 2.3. Models of stress

### 2.3.1. Models

Based on the theoretical approaches described in the last section a number of authors developed more explicit models of stress. It is important to this study to investigate these models, as these may help us to produce a more explicit and detailed account of the relationship between the teacher and the classroom environment than can be provided by the general theories alone.

A range of models of stress have been used in workplace studies, and yet others used in other contexts. The majority of these models are derived from interaction theory or transaction theory. Examples include: the Cycle model (McGrath, 1976); Job demands-control model (Karasek, 1979); Cybernetic model (Cumming and Cooper, 1979); the Person-Environment (P-E) fit model (French, et al., 1982); Institute for Social Research ISR model (1978) (found in Jex, et al., 1998); Stress at work model (Cooper and Marshall, 1976); Spielberger's State-Trait Process (STP) model (Spielberger, et al., 2003); Effort-reward imbalance model (Siegrist, 1996); and Warr's vitamin model (Warr, 1987).

The thesis has chosen to concentrate on the Person-Environment Fit model as this model has been widely used in work-based studies and in some educational studies.

For workplace studies, see Edwards and Cooper, 1990; Gutierres, et al., 1994; Jex, 1998; Cooper, et al., 2001; Spielberger, et al., 2003; and Chemers, et al., 1985. For education studies, see Nielson and Moos, 1978; Fraser and Rentoul, 1980; Pithers and Rebecca, 1999; Ryska, 2002; and Al-Mohannadi, 2004. Such agreement from those researchers has led to the choice of the P-E fit model in preference to other models mentioned above. However, before a final decision was made about using it, it is important to investigate this model and to see how appropriate it was as a framework for the current study.

### *2.3.2. Person-Environment fit model*

In 1951, Lewin observed that "the characteristics of a person interact with environmental stressors to determine how much strain is experienced by an individual and the effects of strain on behaviour and health" (Spielberger, et al., 2003, p. 185). Lewin's observations were developed by French and his colleagues (French, et al., 1974, French, et al., 1982), who developed the P-E fit model. French et al. (1982) stated that the P-E fit model is "based on the assumption that people vary in their needs and abilities just as jobs vary in their incentives and demands. When there is a poor fit between the characteristics of the person and related characteristics of the job, P-E fit model predicts that employee['s] wellbeing will be reduced" (French, et al., 1982, p. 27) (see Figure 1).

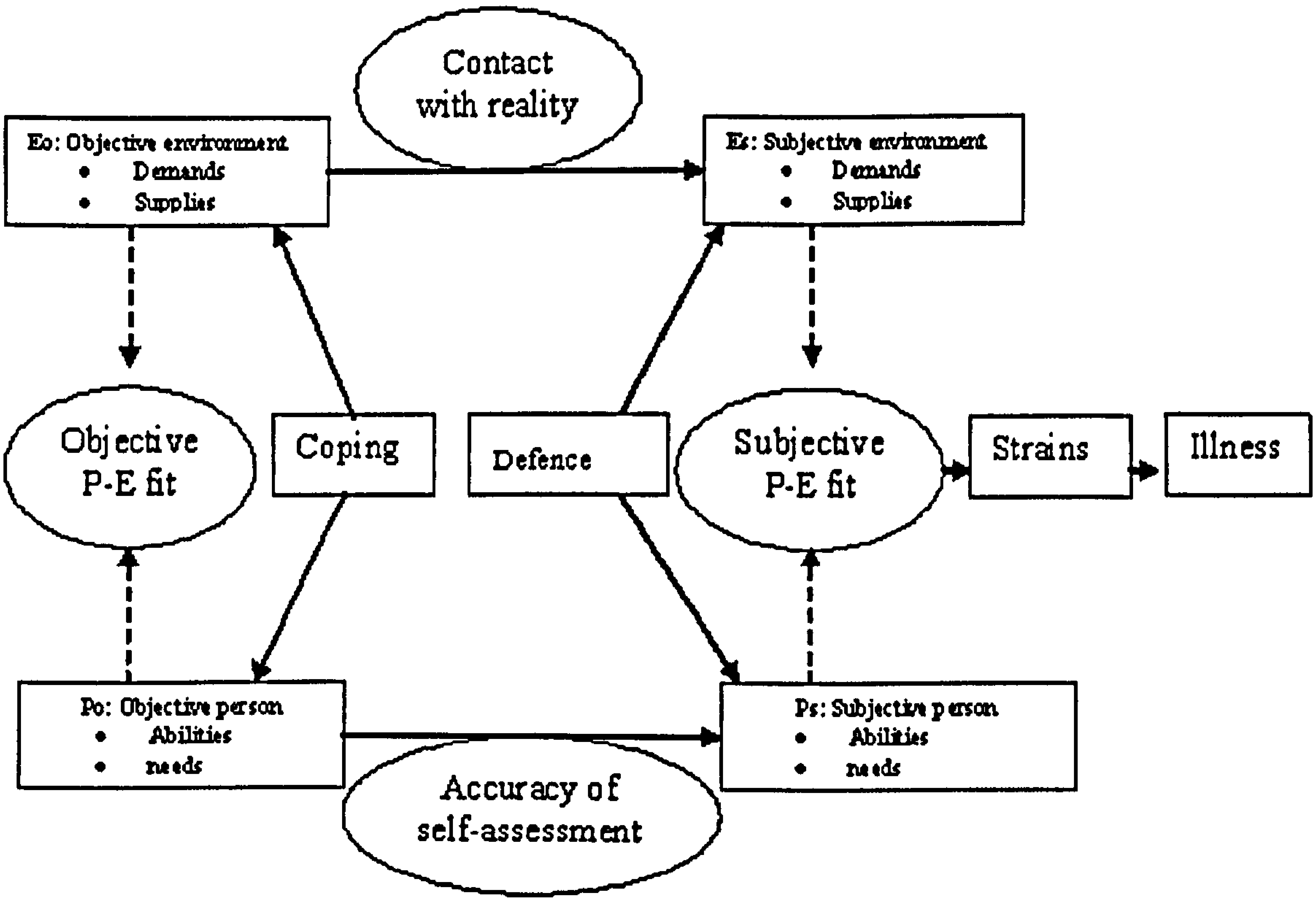


**Figure 1: A model of stress as person-environment fit**

Note: Concepts within circles are discrepancies between the two adjoining concepts. Solid lines indicate causal effects. Broken lines indicate contributions to person-environment comparisons (adapted from Edwards, et al., 1998, p. 29).

The model (Figure 1) consists of four variables (1) the objective environment that is independent from the perception of the person, (2) the subjective environment that is perceived by the person, (3) the objective person as he really is, and (4) the subjective person or self-concept (French, et al., 1974, p. 316). There are two forms of the objective and the subjective environment variables, namely Demand and Supply, interacting with two forms of objective and subjective personal variables, Ability and Need. Edwards, et al. (1998) stated that; "*Demands* refer to quantitative and qualitative job requirements, role expectations and group and organisational norms. *Abilities* refer to aptitudes, skills, training, time, and energy the person masters to meet demands. *Supplies* refer to extrinsic and intrinsic resources and rewards that may fulfil the person's needs such as food, shelter, money, social involvement, and the opportunity to achieve. *Needs* refer to innate biological and psychological requirements, values acquired through learning and socialization, and motives to achieve desired ends" (Edwards, et al., 1998, p: 30-31). Other authors use these terms in slightly different ways, and French, et al., (1982) exchange 'Motives' for 'Needs'. Edwards, et al. (1998) describe four types of correspondence between person and environment: "(1) Objective P-E fit which refers to the fit between the objective person and the objective environment; (2) Subjective P-E fit [which refers to] the fit between the subjective person and the subjective environment; (3) Contact with reality, meaning the degree to which the subjective environment corresponds to the objective environment; and (4) Accuracy of self-assessment, or accessibility of the self, representing the match between the objective person and the subjective person" (p. 30).

Figure (1) indicates that in case of strain due to the poor P-E fit, the individual can choose either to cope or defend. Coping refers to the individual's attempt to change the objective environment (e.g., asking the supervisor to reduce work demands) or to change the objective person (e.g., training to increase the abilities in order to handle the objective demands). Defences refer to "mental processes which distort the person's perception of the objective environment and the objective self" (Harrison, 1978, p. 179), changing the subjective environment or subjective person.

Caplan, et al. (1980) applied the P-E fit model in a cross-sectional study of 2,010 workers in 23 occupations. The study examined the relationship between P-E fit and strain. The study assessed the Demands-Abilities in terms of education and work experience, also measured Supplies-Needs for: job complexity, workload, role ambiguity, responsibility for person, income, and overtime. The results showed a relationship between P-E fit and psychological, physiological, and behavioural strains. Strong relationship for N-S fit regarding the following: job complexity, workload, role ambiguity, and responsibility for person were found (Caplan, et al., 1980).

Many other studies applied the P-E fit model to test the Needs-Supplies relationship to predict the job satisfaction. These studies suggested that if supplies increased towards needs, then job satisfaction increases (see Edwards, et al., 1998).

Edwards, et al. (1998) described three significant limitations of this model: (1) the P-E fit model does not specify the content of person and environment dimensions, (2) it does not propose a prior hypothesis regarding the relationship between P-E fit and strain, (3) it devotes limited attention to coping and defence (p. 39). Edwards and

Cooper, (1990) discussed some studies that used the P-E fit model and stated that "perhaps the most serious problem regarding current P-E fit research involve procedures used to analyze the effects of fit" (p. 301). This inability to operationalise the effects of fit led Owens to argue that the P-E fit model should be regarded more as a conceptual framework rather than an empirically testable model (Owens, 2005, p. 64).

Despite these limitations, the nature of this particular study, which looks at the place of the individual teacher in a technological environment, makes an intuitive fit with the P-E model, and the widespread use of this model made it a prime candidate for consideration for use in the present study. Nevertheless, because this study will use the transactional theory as stated above (see 2.2.3.2), and as the relationship between the chosen model (P-E fit) and the transactional theory is not clear yet, the following section therefore will investigate the relationship between them, and thus the possibility of using this model in this study.

### *2.3.3. The P-E fit model and transactional theory*

The relationship between the P-E fit model and the interactional and transactional theories is somewhat unclear. Some researchers see no difference between the two theories and use them as one theory (for example, Ross and Altmaier, 1993). Some researchers see the P-E fit model as derived from interactional theory (see for example Lazarus and Folkman, 1984; Grimshaw, 1999; and Jovanovic, 2006). Yet others relate the P-E fit model to Lazarus' transactional approach (see Al-Mohannadi, 2004; Owens, 2005; and Rintala, 2005). Cooper et al. (2001) belong to this last group, and argue that "The main point is that subjective P-E misfit – that is, how individuals perceive the encounter – increases the likelihood that strain will occur. Implicit in the notion of misfit is the individual's ability to manage an encounter, and elements such as values, supplies, demands, and abilities, all of which help to determine the perceived misfit, could be described as representing aspects of a transactional process" (p. 17).

Spielberger and Reheiser (1995) argue for using transactional theory and P-E fit model in a complementary way: "Lazarus' conception of occupational stress and Person-Environment fit theory both have merit and limitations, and can be construed as complementary rather than contradictory in providing a meaningful conceptual framework for understanding stress in the workplace" (p. 55). Brief and George (1995), and Harris (1995) also argue that the two are complementary.

As the section showed that the P-E fit can be used as complementary with the transactional theory, therefore, it was decided to use this model. The current study will work with the conception of transactional theory (see 2.2.3.2) and the P-E fit model as complementary.

The research questions conceptualise stress in terms of causes, symptoms, and coping strategies, and so the next section takes each of these elements in turn and looks at the research related to each, and how they fit together as a description of 'stress'.

## 2.4. Causes, Symptoms, and Coping

The transactional theory stated the importance of the appraisals process, in which the person should be aware of the threat (the cause), then he/she starts to respond to the threat by identifying the availability of the coping resources and the chances of success, during this process the person experiences different symptoms, however he/she then should start to cope with the threat. This statement raises the importance of understanding the nature of the causes, the ways the body of the person responds to the causes, and the person's ways of coping with stress. Cooper, et al. (2001) argued that the overall stress process includes **stressors** [that cause stress], **strains** [physical, psychological and/or behavioural symptoms], and **coping responses [coping strategies]**", (p. 14). These three components of the stress process (causes, symptoms, and cooping) will be discussed in the following sections. This discussion will focus principally on studies that were conducted in workplaces.

### 2.4.1. Causes of stress

A range of studies investigating workplace stress have reported a range of different causes of stress. Factors reported were such as; unreasonable deadlines, difficult relationships with others, lack of feedback, unclear duties, and lack of control as stressors (Younghusband, et al., 2003); workload, worry, anticipation, helplessness, and executive roles (Wilson, 2002); deficiency of job resources, poor social support (Caplan and Harrison, 1993); crowded work areas, noise, inadequate light, and poor ventilation aggression, intrinsic characteristics, task demand, role demands, over-and under-work (Sharif, 2000); work pace, work schedule, career security, job context (Jex, 1998); shift work, long hours, travel, risk and danger, new technology, and the quality of the physical working environment (Danna and Griffin, 1999), Dunna and Griffin also reported that uncertainty and abstractness in advanced manufacturing technology produced psychological strain.

Three main categories of causes can be identified: job characteristics, organisational factors, and personal characteristics (Cooper, et al., 2001):

- Job characteristics include variables such as: level of *job complexity,* variety of tasks requirement, the amount of discretion and control that individuals have over the pace and timing of their work, physical environment such as noise, vibration, extremes of temperature, workload, work hours, *technology changes*, and exposure to risk and hazards.
- Organisational factors include the structure, the climate, the culture, and political environment of the organisation.
- Personal characteristics include type A behaviour, negative affectivity, self-esteem self-efficacy, hardiness, and locus of control. (Type A individuals are "characterized as displaying a very high level of concentration and alertness, achievement striving (ambitiousness), competitiveness, time urgency, and aggressiveness." (p. 121). Locus of control refers to "a generalized expectancy of having control over life events and hence is a dispositional construct." (p. 133).)

The majority of studies pay attention to workplace characteristics, and often recommend management procedures to cope with such problems. Less attention has been paid to personal characteristics. The focus of these studies was often on causes in order to find some solutions, and the conclusions have little to say about personal characteristics. Factors underlying this choice of focus might include:

- Easy to find: it is much easier to indicate job characteristics and the limitations that cause problems to the workers.
- Easy to control: it is easy to control such problems or establish some strategies to deal with them.
- Difficult to diagnose: it is difficult to identify peoples' abilities, beliefs, attitudes, behaviours, and skills.
- Difficult to treat: therefore, it is difficult to find strategies to deal with these variations.
- Fixed Ideas: researchers assume that it is easier to change environments than to change people.

### *2.4.2. Symptoms of stress*

In stressful situations people may experience physical, behavioural, and/or psychological symptoms. The following sections highlight some examples of these symptoms.

#### Physical symptoms

In stressful situations, the body rapidly responds by releasing adrenaline into the blood stream, which results in physical changes, for instance: "increased pulse rate and increased blood pressure which leads to blood circulation improvement to the muscles. This also stimulates the nervous system, faster blood clotting time, raising blood sugar that supplies more energy to the muscles, decreased peristalsis and stomach digestion" (Younghusband, et al., 2003, p. 5). Researchers have demonstrated that blood pressure is sensitive to acute stress and acute emotional arousal; Galvanic Skin Resistance (GSR) measures are useful to determine overall somatic arousal associated with a particular stressor; Electromyography (EMG) measures muscle tension, where the forehead frontal muscles have been noted to be responsive to emotional arousal; cardiovascular activity represents a physiological response system to stress (Ronald and Jason, 1994). Different physical symptoms were identified in the literature, for example, in the report by the Assistant Masters and Mistresses Association [AMMA]; working party on stress in 1987 - an increase of catecholamine secretions, cholesterol secretions, heartbeat, breathing rate, sweating; dryness of throat and mouth; and nausea were observed. Sharif (2000) enumerated heart disease, stroke, gastrointestinal disorders, respiratory problems, backache, headache, diabetes, liver cirrhosis, and skin disease as symptoms of stress. Methods such as questionnaires, case studies, interviews and reviews, meta-analysis, physiological indicators, and medical diagnosis were used to investigate the symptoms of stress in these studies.

### Behavioural symptoms

Jones and Bright (2001) argued that behavioural outcomes are important for studies focusing upon diseases, health behaviours, work stress and the relationship between stressors and work performance. Ronald and Jason (1994) described behavioural symptoms such as avoiding things, doing things to extremes, personal neglect, and judgment problems. Sharif (2000) mentioned drug use and abuse, over-and under-eating, poor interpersonal relations, accident proneness, abusive behaviour, humour, avoidance, withdrawal, anger, and seeking revenge and violence (p. 110). Factors such as heavy indulgence in smoking, alcohol or food, drug taking, impulsive behaviour, inability to concentrate, displays of emotion (the urge to cry, run, or hide), trembling, nervous laughter, speech difficulties, taking short cuts, and working excessively, were reported (AMMA's working party of stress, 1987). Jellies in 1996 described deterioration in work performance and interpersonal relationships as behavioural symptoms. Also, in work-related stress, behavioural responses such as low job performance, turnover, and absenteeism (as an organisational category) and alcohol use, smoking and destructive behaviour (as an individual category) have been identified (Cooper, et al., 2001).

Researchers used questionnaires and self-reports to investigate such behavioural symptoms. Cooper, et al., (2001) noted that using self-reports and cross-sectional analyses of behavioural indicators of strain have been criticised because these indicators might be due to other factors such as life events. They recommended interviewing people as the most appropriate approach to describing behavioural responses (p. 69). They also argued that the relationship between behaviour and stressors in workplaces is complex because of the difficulty of understanding the link between the variables.

### Psychological symptoms

Psychological symptoms are considered to be much more easily observed and are commonly used where ***good*** behavioural and physiological measures are unavailable, particularly in workplace studies (Cooper, et al., 2001). There are a range of symptoms of stress such as apathy, irritability, mental fatigue, overcompensation or denial (Ronald and Jason, 1994). The AMMA's working party (1987) reported: anxiety, frustration, tension, fatigue, irritability, boredom, depression, feelings of threat, low self-actualisation, low self-esteem, and job dissatisfaction.

Measures used are questionnaires, and a number of scales have been used, see for example: Goldberg, 1972; Crown and Crisp, 1979; McNair, Lorr and Droppleman, 1981; Davies, 1986; Watson, et al., 1988; Ronald and Jason, 1994; Cooper, et al., 2001; Jones and Bright, 2001; Kessler, et al., 2003.

### *2.4.3. Coping with stress*

Lazarus argued that when threat occurs, usually some behaviour or psychological process is activated for the purpose of mitigating or eliminating the threat. This activity is called coping (Lazarus, 1966, p. 28). There are two dominant categories of coping strategies: the *problem-focused* and the *emotion-focused.* Problem-focused strategies are "directed at defining the problem, generating alternative solutions, weighing the alternatives in terms of their costs and benefits, choosing among them, and acting" (Lazarus and Folkman, 1984, p: 152). Whereas in emotion-focused strategies, "attempts are made to deal with the emotional disturbance resulting from those demands" (Cooper, et al., 2001, p. 165).

Some studies have reported that problem-focused coping strategies are associated with low level of strain rather than the use of emotion-focused coping strategies (Lazarus, 2006, p. 124). For example, using a plan to solve problems by a soldier - undergoing training - was reported to be associated with low level of strain, whereas high strain was associated with self-control strategies (Chin-Yi, 2003).

The choice of either strategy depends on different factors such as personal or environmental resources, the length of the event, the importance of the situation and the appraisal of the individual. For example, people with resources such as social support might choose the active coping strategies and attempt to manage the event directly. Lazarus and Folkman, (1984) stated that an individual's way of coping is determined "in part by his/her resources, which include health and energy, existential beliefs, (e.g., about God, or general beliefs about control), commitments, which have a motivational property that can help sustain coping, problem-solving skills, social skills, social support; and material resources" (p. 179). Factors such as "personal constraints (e.g., internalized cultural values and beliefs that proscribe certain ways of behaving and psychological deficits); environmental constraints (e.g., demands that compete for the same resources, and agencies or institutions that thwart coping efforts) ... and high levels of threat" might also mitigate the use of resources effectively in coping (p. 179).

Individuals might resort to emotion-focused coping strategies if the environment is threatening and causing high stress, because they could not control it according to their abilities and skills, therefore there is a preference for avoiding the situation (Hepburn et al., 1997). In addition, a short-term threat might be avoided by an individual but a long-term threat might be dealt with. Sometimes the selection of the strategies by the individual depends on the difficulty or the inadequacy of using the other. For example, emotion-focused strategies were found to have an effect on reported anxiety, psychological distress, depression, and Type A behaviour. Pessimists and women were also found to prefer the emotion-focused strategies (particularly avoidance techniques), whereas optimists and men were found to be more likely to engage in problem-focused strategies (Carver, et al., 1989).

Using problem-focused strategies was found to be associated with self-efficacy (Fleishman, 1984; Bachrach and Zautra, 1985; Carver, at al., 1989), and positive work experiences, whereas emotion-focused coping strategies were found to be contributing to negative work experiences (Hart, et al., 1995).

Having discussed stress in the workplace the following section will discuss stress in education. The main focus of this study is on stress in the classroom, so in the next section the literature related to classroom stress is examined, with the particular aim of identifying any specific characteristics of stress in the classroom and in particular, its causes.

## *2.5. Stress in Teaching:*

Stress in teaching is probably little different from stress in everyday life and stress in the workplace. Teachers are often occupied by several things at once, and they have to deal with students, colleagues, parents, administrators, administrative work, and the curriculum. Moreover, they have to prepare for and develop their skills to cope with these factors and changes, in order to survive in their complex environment. Teachers as reported by some studies work under difficult mental and emotional demands (Renshaw, 1997; Adams, 2001). Researchers think that because of the overload, the ambiguity, and the conflict in teaching, it is considered to be a stressful occupation (see, for example, Milstein and Golasziewski, 1985; Travers and Cooper, 1996; Vandenberghe and Huberman, 1999; Adams, 2001; Kyriacou, 2001; Younghusband, et al., 2003; Arikewuyo, 2004).

Studying stress among teachers has been ongoing since the 1930s when discussions about the health of teachers were first reported (Smith and Milstein, 1984). They were, according to Kyriacou (2001), referring to upset and frustration before using the term 'stress' in relation to teaching, and in the mid 1970s some studies referred to 'stress in teaching'. The term 'teacher stress' had appeared by 1977, its use grew rapidly in the 1980s, and by the end of the 1990s, the term was established and had become part of popular discourse (Kyriacou, 2001, pp. 27-28)

### 2.5.1. Causes of stress in teaching

A range of studies that have looked at teacher stress were selected for particular analysis to determine the range. The purpose of reviewing them was to: (a) know the variety of factors, (b) know the main causes of stress in different times, (c) know whether there were any changes of factors with the change of the time, (d) know whether there was any mention of technology as a factor that causes stress in teaching. Because the main investigation concerns technology, the choice of studies was restricted to those done post-1990. No other consistent criteria were used in the selection of the studies, though they have all been widely discussed, and in particular are mentioned in other reviews of the literature. The studies that were reviewed were: ESAC (Great Britain Education Service Advisory Committee) (1990); Dunham, (1992); Jellies (1996); Travers and Cooper (1996); Kyriacou (1997); Vandenberghe and Huberman, (1999); Kyriacou (2001); Jacobson, et al., (2001); Adams (2001); Jarvis (2002); Younghusband, et al., (2003); Kelly and Colquhoun, (2003); Williams and Gersch (2004); and Bubb and Earley (2004).

Based on these studies, some causes of stress within the classroom were commonly reported i.e. time, students' misbehaviour, work overload, change, and curriculum. Moreover, reviewing theses studies tells about the nature of the environment and the perceptions of the participants. Also tells about the likelihood of the unmet between teachers and their environment in some situations and under different circumstances (see for example Younghusband, et al., 2003). Although some of these studies applied different approaches, yet they follow the core premise of the P-E model, which concerns the fit/misfit between the person and his/her environment. Also it could be argued that what has been reported by researchers about teachers' stress and the number of factors that cause stress to them indicates the complexity of teaching environments and highlights the difficulties experienced by teachers. Moreover, technology was not among the factors that were appraised to cause stress to teachers in the studies above, yet change, work overload, time pressure, and workplace environment were among the main perceived causes of stress in the classroom.

Many of these factors can be summarised under the headings used above in looking at the causes of stress more generally in section 2.4.1.

(a) Job characteristics such as: change (Travers and Cooper, 1990; ESAC, 1990; Jellies, 1996; Kyriacou, 1997; Dunham, 1992; Kyriacou, 2001; Bubb and Earley, 2004), work overload (Kyriacou, 1997, Kyriacou, 2001; Dunham, 1992; Bubb and Earley, 2004), role conflict, role ambiguity (Milstein and Golasziewski, 1985; Travers and Cooper, 1996; Adams, 2001; Kyriacou, 2001; Younghusband, et al., 2003; Arikewuyo, 2004), time (ESAC, 1990; Jellies 1996; Kyriacou 1997; Kyriacou, 2001; Bubb and Earley 2004), students' misbehaviour (Travers and Cooper 1990; ESAC, 1990; Kyriacou, 1997; Kyriacou, 2001 Adams, 2001; Bubb and Earley 2004), curriculum (Travers and Cooper, 1990; Jellies, 1996; Adams, 2001).

(b) Organisational factors such as: support (Younghusband, et al., 2003), type of school (Johnstone, 1989; Chen 2003), school resources (Jellies, 1996; Chen, 2003), workplace environment (ESAC, 1990; Jellies, 1996; Kyriacou, 1997; Dunham, 1992; Kyriacou, 2001; Bubb and Earley, 2004), low motivation (ESAC, 1990; Dunham, 1992) promotion and development (Kyriacou, 1997), school system (Camp and Heath-Camp, 1990; Adams, 2001; Jarvis, 2002).

(c) Personality characteristics such as: negative affectivity (NA), optimism, hardiness, locus of control, Type A behaviour, self-esteem, and self-efficacy experience, level of ability, and fear of negative evaluation (Al-Mohannadi, 2004); appraisals and abilities due to mental and emotional factors; (Kyriacou and Sutcliffe 1978a); age, gender, vulnerabilities, teachers' beliefs (Johnstone, 1989) self-consciousness, coping styles, neuroticism and empathy (Vandenberghe and Huberman, 1999); skills, values (Kyriacou, 2001). Contradictorily, there are some studies which stated that in terms of 'stress perception', individual variables such as sex, age, and teaching experience might not be that important (found in Chen, 2003). Initially, Kyriacou and Sutcliffe (1977) argued that the way the teacher assesses the demands made upon him/her depends on his/her personal characteristics and his/her perception of the demands. In one of their later studies (1978b), they found that characteristics such as sex, qualifications, age, length of teaching experience, and position held at school had little to do with the teacher's experience of stress. Other studies also reported 'no relation between gender and stressors' (see, for example, Danna and Griffin, 1999).

The increased use of technology in the classroom makes the investigation of its possible relationship to teacher stress a timely study. Technology may have helped teachers to manage their workload and save time in the classroom, and so may have lessened the impact of some stressors. Has the fit between motives and/or abilities of teachers and the demands of their jobs become better or worse now that technology is widely used in the classroom? The next chapter will raise some issues about the role of technology in society and in education.

### 2.5.2. Symptoms of stress in teaching

Symptoms in teaching are not different from those in general life or in the workplace. There are:

- Physical symptoms such as headaches, migraines, ulcers, back/neck problems.
- Behavioural symptoms such as appetite disorders, excessive smoking and alcohol and/or drug abuse, violence, inability to sleep, absence and resignations.
- Psychological symptoms such as anxiety, dissatisfaction, depression, fear, frustration, low self-esteem, and burnout. (Travers and Cooper, 1996, p. 20-21)

Methods such as cross-sectional studies (most common); longitudinal studies; surveys; objective measurements that study the behaviour and performance characteristics (e.g., rate of absence, alcohol and drug abuse); biofeedback studies of which there are few (e.g., physiological, biochemical, and immunological studies) have been used to investigate stress in teaching (see, for example, Johnstone, 1989). Rudow (1999) suggested that behaviour and performance characteristics would be excellent tools to complement subjective reports studies and biofeedback studies of stress, this suggestion was also found in an extensive literature review by Wilson in 2002 (which updated earlier reviews conducted by the Scottish Council for Research in Education [SCRE] in 1989 and 1993) who further recommended that triangulated sources could help the validity of the findings and overcome the limitations of self-report findings that were open to challenge. Experimental studies were used also to measure stress in education. Studies which used laboratories to measure stress in physiological terms seem to be limited because of the complexity of replicating real-life circumstances and stressors that were used in such studies, and which did not reflect naturally-occurring stressors such as loud noise or wrong information (see, for example, Johnstone, 1989, and Fisher, 1994)

Some researchers have argued that figures that show the number of teachers retiring because of ill-health and those who leave teaching or ask for early retirement can be useful to show teaching as a stressful occupation (see, for example, Kyriacou, 1997). Nevertheless, Wilson and Hall (2002) stated that absence rates and figures for early retirements – they quoted Bowers and McIver (2000) - are "by no means uniform across the teaching profession, nor can all absences be attributed to stress" (p. 178).

The above discussion shows the disagreement about ways of measuring the stress in the teaching profession.

Some studies were conducted to measure teacher stress using physiological, biochemical and immunological reactions. Measurements such as blood pressure, heart rate, pulse rate, EKG, catecholamine, and hormones in the urine were conducted in the classroom (see, for example, Rudow, 1999; Leonard, 1984; Johnsone, 1989; Kyriacou, 2001; Smith, 2005).

### 2.5.3. Coping with stress in teaching

Teachers use different strategies to deal with stress. Dunham (1992) described four strategies: personal, interpersonal, organisational, and community. Different techniques were recommended to help teachers manage stress, e.g. training, relaxation, time management (doing important things first by setting priorities and scheduling); classroom management (learning programmes that increase teacher's confidence to handle the classroom); emotional management (help to change teachers' beliefs about their limits); healthy lifestyle (eating well and exercising regularly); asking, listening to, and learning from colleagues; moreover, it is assumed that any support for teachers will help to reduce the sources of stress (Chen, 2003; Dunham and Varma, 1998; Turner, 2000, and Gao, 2005). If teachers felt secure in the school and in the community, that would help them to cope effectively with stressors.

As with stress generally these coping strategies can generally be classified into one of two dominant categories: the *problem-focused* and the *emotion-focused.* Based on a review of studies, Kyriacou (2000, pp. 63,85) described several problem-focused coping strategies used by teachers such as taking action to deal with problems, devoting more time to particular tasks, planning ahead and prioritising. He also reported some emotion-focused coping strategies such as putting things in perspective, seeing the humour in the situation, thinking of positive things and emotional control. Other studies reported that some teachers use negative behaviour such as alcohol, drugs, tobacco and shouting at students, but these negative behaviours were proved to cause psychological distress and were less successful for teachers in the longer term (Chin-Yi, 2003, pp. 44-47).

## 2.6. Conclusion

Three approaches - physiological, environmental and psychological - have been used to define stress. The psychological approach can be seen as encompassing the environmental and physiological approaches, and shows the interactions between the variables rather than investigating one part of the equation. As in this study the researcher cannot assume that the causes of stress lie either exclusively in the technological environment or in the teacher, such an interactional perspective is appropriate. The transactional theory has emerged from the psychological approach and discusses the process of the interaction between the person and the environment, the appraisals and coping processes, and this would seem to be an approach suited to this study. The transactional theory describes the interaction in the P-E fit model, which will be used in this study as a theoretical framework for investigating the misfit between teachers and technological classroom environment that might cause stress. Using the P-E fit will help to investigate whether there is a misfit between teacher's ability and the demand of the classroom environment, or a misfit between the teacher's needs and the classroom environment supply. Stress as described in the transaction theory goes through different processes that include: awareness of the cause, and assessment of the capability to respond process, and then through coping strategies process. These two processes usually accompanied with physical, behavioural, and/or psychological symptoms. Understanding the nature of these elements (causes, symptoms, and coping) provides a full picture of the stress, and furthermore it helps the researchers in the field to investigate the existence of stress in much appropriate and confidence way. Measuring causes, symptoms, and coping strategies can be accomplished by using interviews and/or questionnaires as common methods. However, physiological, biochemical, and/or immunology reactions measurements are good methods for measuring symptoms of stress, and play an important role in supporting the data gained from the questionnaire and from the interview methods. These methods have been used widely in the workplace and in teaching. In order, therefore, to reduce the likelihood of the limitations of some approaches (e.g., physiological and/or environmental approaches) and/or the limitations of some measurements, as indicated in the literature above, this study is aiming to use more than one common method in addition to a physiological and /or biofeedback indicators method.

# Chapter Three

## TECHNOLOGY AND STRESS

### *3.1. Introduction*

Technostress is a common term in use in daily life and in the workplace, referring to stress related directly or indirectly to the use of technology. Technology per se is not a source of stress; but rather that "the expected direct or mediated consequences of its implementation" causes stress to individuals (Hamborg and Greif, 2003, p. 162-163). Many writers have talked about the possibilities of tensions (or/and feelings of unease) arising when people deal with technology (see Kirsh, 2000; Bradley, 2003). A range of literature (see, for example, Weil and Rosen, 1997) has pointed to increased experience of stress associated with technology use, which leads one to expect that teachers may also experience stress when using technology in addition to the ordinary levels of stress experienced by teachers. Although there are some studies (see, for example, Hudiburge, 1996; Humphrey, 2000) in the literature about technology and stress/anxiety in education, some authors have expressed the opinion that there have been as yet too few studies looking at technostress in education (Shepherd, 2004) or health and safety issues and the use of technology in schools (Lai, 2000).

The issue of technostress has been discussed for many years. Brod introduced the term 'technostress' in 1984 and defined it as "a modern disease of adaptation caused by an inability to cope with the new computer technologies in a healthy manner. It manifests itself in two distinct and related ways: in the struggle to accept computer technology and in the more specialized form of over-identification with computer technology" (Brod, 1984, p.16). This present study will not use Brod's definition of technostress - the definition that will be used will be described below - though it could be seen as focussing on the first form of technostress described by Brod. Weil and Rosen, described technostress as "any negative impact on attitudes, thought, behaviours, or body physiology that is caused either directly or indirectly by technology" (Weil and Rosen, 1997, p.5).

In education, many researchers use the same definition of technostress as that used by Brod (1984) above (see, for example, Hedberg, 1989, Hudiburg, 1996, Humphery, 2000, Shepherd, 2004, Burke, 2005). Other studies in education relate technostress to computer-related anxiety (see Genco, 2000) and others to 'perceived technical competence' (Shamoail, 2005, p. 70).

Technostress can be seen as being similar to any other kind of stress; therefore, what has been discussed in the previous chapter (about transactional theory and the P-E fit model) can be applied to define technostress in the classroom. This study sees technostress as stress that is experienced by a person due to the misfit between his/her need/ability and the supply/demands of the technological environment. The misfit occurs in both forms (demand/ability form and supply/need form) when the event or the situation is appraised and evaluated by the teacher as a threat that could not be controlled or managed due to lack of recourses, abilities, chances of success, on the part of the teacher. During these processes the teacher might experience some symptoms, and the appraisal and the evaluation prepare the teacher to cope with this stress.

This chapter will first consider technostress from the point of view of causes, symptoms, and coping as it has been done for stress in Chapter 2, and will then go on to present a model of technostress derived from the work reviewed in Chapter 2 and the first part of Chapter 3, and then present the conclusion relevant to the further development of the study

## 3.2. Causes of technostress

The factors that have been identified as causing workplace stress have changed over time, for example, 'extremes of temperature' was an important factor in early studies, but nowadays factors such as technology have become dominant concerns in the workplace presumably due to the type of technological changes people and organisations have recently experienced (see, for example, Kirsh, 2000; Weil and Rosen, 1997; Cooper and Stevenson, 1998; Cooper, et al., 2001; Hamborg and Greif, 2003). Nowadays, people work with, communicate with, and even speak to machines. These changes have been seen by some authors as a threat, because they are seen as not fitting well with human needs and abilities. Allen (1998) discussed the stressful effects generated by twentieth century work patterns. His discussion was developed by Kelly and Colquhoun, (2003) who stated that "our physical and emotional selves and the brain chemistry responsible for our emotional states have changed very little in the past 20,000 years. Yet, in that time we have moved from a species of self-paced nomadic 'hunters and gatherers' to a species that works in environments that are technologised, rationalized and regulated by processes and practices quite distanced from us...Parkin stated that people are not Pentiums ... they have physical and emotional needs that do not cease to exist at work" (pp. 196-197). Technology has led to an alienated work environment, and this has consequently, resulted in stress experienced by many workers (see, Sharif, 2000).

A range of studies have investigated technostress and have reported a variety of ways in which technology can contribute to stress. A number of studies that have looked at technostress were selected for particular analysis. The purpose of reviewing them was to show (a) the nature of the factors, (b) the variety of these factors, and (c) whether there were any similarities between the factors in these studies. No strict criteria were used in the selection of the studies, though they have all been widely discussed, and in particular are mentioned in other reviews of the literature. Some of these studies use terms such as 'anxiety' and 'user cost' rather than technostress, but they will all be considered here as related to technostress.

In Chapter 2 the causes of stress were classified as job characteristics, organizational factors, and personal characteristics, and so the causes of technostress are classified under the same headings. These are summarized in Table 1, and further details are provided below.

| Causes | Study |
|---|---|
| **Job characteristics** | |
| **a) Social characteristic** | |
| Isolation (limited opportunities for social interaction among co-workers) | Coovert, et al., 2005; Coovert and Thompson, 2003; Humphrey, 2000; Ogan and Chung, 2003 |
| Invasion (technology invading personal lives, so less time is spent with family or on vacation, giving the time over instead to learning about new technology) | Wang and Shu, 2005 |
| **b) Technological characteristic (Performance)** | |
| Too many passwords, hardware failure, computer crashes | Aborg, 2002; Bai et al., 2000; Hamborg and Greif, 2003; Hudiburge and Necessary 1996; Humphrey, 2000; Johansson-Hiden et al., 2003; Kupersmith, 2005; Shepherd, 2004 |
| Badly designed software | Carayon, et al., 1999; Kupersmith, 1992, 2005; Rovai and Childress, 2002; Wilson and Sasse, 2000 |
| Long response times | Aborg, 2002; Hamborg and Greif, 2003; Trimmel, et al., 2003 |
| **c) Technological characteristic (Impact on user)** | |
| Information overload | Aborg, 2002; Clute, 1998; Harper, 2000; Kupersmith, 2005; Shepherd, 2004 |
| Uncertainty (constant changes in computer hardware and software) | Aborg, 2002; Harper, 2000; Hamborg and Greif, 2003; Voakes, et al., 2003; Wang and Shu, 2005 |
| Disruption | Aborg 2002; Bunge, 1991; Johansson-Hiden, et al., 2003. |
| Multi-tasking (manage too many tasks at the same time) | Weil and Rosen, 1997 |
| Workload | Carayon, et al., 1999; Coovert, et al., 2005; Hamborg and Greif, 2003; Wang and Shu, 2005 |
| Work pace (faster work speed) | Coovert and Thomson, 2003; Wang and Shu, 2005 |
| Conflict (conflict with worker's desire to provide quality customer service, and conflict with management's demands for quality) | Hamborg and Greif, 2003 |
| Change (change of work habit caused by new technology) | Carayon, et al., 1999; Wang and Shu, 2005 |
| Complexity (the inability to learn or deal with the complexity of new technology) | Wang and Shu, 2005 |
| **Organisational factors** | |
| Inadequate training | Bichteler, 1986; Clute, 1998; Kupersmith, 2005; Rovai and Childress 2002; Voakes, et al., 2003. |
| Electronic performance monitoring | Coovert et al., 2005 |
| Poor ergonomics | Harper, 2000 |
| Lack of technical support | Bai, et al., 2000; Edwards, et al., 1995; Kupersmith, 2005; Voakes et al., 2003. |
| **Personal characteristics** | |
| Computer obsession | Kupersmith, 1992. |
| Inexperience | Clute, 1998; Hudiburge and Necessary, 1996 |
| Technophobia | Humphrey, 2000 |
| Negative attitude towards technology | Bai, et al., 2000; Rovai and Childress, 2002 |
| Hesitancy | Weil and Rosen, 1997 |
| Insecurity (fear of being replaced by more skilled people and the constant push to update technical skills) | Coovert, et al., 2005; Hamborg and Greif, 2003; Harper, 2000; Wang and Shu, 2005. |

**Table 1: Causes of technostress as reported in the literature**

The review of these studies showed a variety of causes of technostress, the largest group of causes are those classified under job characteristics, and these need to be considered as an important set of factors. Following are descriptions of job characteristics, the organisational factors, and the personal characteristics.

**Job characteristics:** in this group, there were social characteristics, technology characteristics (performance), and the technology characteristics (the impact the technology have on the user).

**Social characteristics:** included such factors as isolation and invasion see, for example, Coovert and Thompson, (2003) who argued that the fact that technology is considered as a cause of isolation from social interaction and is something that many people have sought to avoid, indicates the extent to which this area is viewed as being problematic (p. 229). Some studies found differences by gender for isolation as a cause of technostress (for example, Ogan and Chung, 2003) in a re-analysis of data from Voakes, et al. (2003) showed that female teachers reported feelings of isolation more often than their male colleagues reported. An example of 'invasion' was found in Wang and Shu (2005), who reported examples of technology invading personal lives, so "less time is spent with family or on vacation, giving the time over instead to learning about new technology" (pp. 78-88).

**Technological characteristics (performance):** included such factors as errors, bad performance/design. These characteristics were about problems of technology, where some studies reported that problems of hardware and software, computer lock-up, and loss of in-put (Hudiburg and Necessary, 1996), badly designed software (Kupersmith, 1992), poor system performance (Carayon, et al., 1999), malfunctions and interruptions (Johansson-Hiden, et al., 2003), computer runtime problems (such as hardware failure, computer crashes) (Shepherd, 2004), networking and computer hardware problems (Kupersmith, 2005) were related to technostress. In an educational study, Humphrey (2000) interviewed a small group of teachers and educators and found that they reported errors and using new applications as causes of technostress. Wilson and Sasse (2000) investigated the impact of technology quality on users, using physiological indicators of stress such as Heart Rate (HR) and Blood Volume Pulse (BVP) and concluded that inadequate media quality causes stress to users. Long response times and unexpected stoppages were considered as other causes of technostress by Aborg (2002). Aborg notes that these causes lead the user to experience feelings of uncertainty and helplessness, asking questions like "What happened? Did I make an error? How long will it take? What shall I do now?"(p.18). In the same manner, another empirical study carried out by Trimmel, et al. (2003) named system response time (SRT) as a cause of stress to the Internet user. They stated that "the psychophysiological parameters during the waiting time of the SRT showed that the system-related interruptions during the Internet search evoked a stress response." That is, they observed an increase in the heart rate of some users while they were waiting for a response. They interpreted the association between the length of SRT and the increase in the heart rate "as a sign of processes of attention and orientation caused by the lack of control during the SRT." They recommended that 'short SRT should be provided' for users; and that in cases where long SRT was unavoidable that users should learn coping strategies such as changing the focus of attention while waiting for responses from the system. Hamborg and Greif (2003) mentioned some groups of hypothetical stressors at work among them were:

1. Additional demands on the action regulation process or control of task performance (for example, long and unpredictable system response time, a flickering screen, and indirect consequences such as time pressure following higher demands for quick proof corrections).
2. Regulatory insecurity or insufficient control of action resulting from overload or blurred performance feedback (for example, complex hardware and software systems or handbooks, unclear prompts, the program's error messages, and, finally, higher complexity of the whole set of tasks).

**The technological characteristics (the impact on the user):** included factors such as workload (Carayon, et al., 1999), information overload, uncertainty, pace etc. (Weil and Rosen, 1997; Harper, 2000; Kirsh, 2000; Kupersmith, 2005). In a study that investigated the relationship between technostress and computer skills by Shepherd (2004), on faculty members in colleges of Business and Education and academic librarians, the author listed some causes of technostress. The most reported causes were computer information problems (such as difficulty keeping up, too many passwords). Wang and Shu (2005) reported "Techno-overload, which refers to greater workload, faster work speed, or change of work habit caused by new technology; Techno-complexity, which refers to the inability to learn or deal with the complexity of new technology; and Techno-uncertainty, which refers to uncertainty of technology (such as constant changes in computer hardware and software)" (pp. 78-88). Hamborg and Greif (2003) considered "conflicting goals or lack of task and role clarity (for example, conflicts between time pressure and quality standards of users for producing good graphic presentation slides, or unclear role changes resulting from the implementation of the technology)" as one of the groups of hypothetical stressors at work.

**Organisational factors:** for example lack of training provision and/or technical support, and monitoring. A review of the literature on technostress conducted by Clute (1998) showed that many researchers reported inadequate or nonexistent training as causes of technostress. Lack of technical support was found to cause anxiety by Edwards, et al. (1995), who investigated the impact on people of electronic libraries in six UK universities, using a survey and a series of eighty-two interviews. Also poor ergonomics at computer workstations was reported as leaving staff feeling drained in a study by Harper (2000). Voakes, et al. (2003) also concluded that inadequate training, inadequate technological support, and difficult access to technical support staff caused high levels of technology-related stress. Their study was conducted among members of a journalism and mass communications faculty. They used a questionnaire and an interview and found that of the 403 participants, only 25% stated they experienced no technology-related stress and 77% reported they needed training in the use of technology. In another review of the literature on technostress, Coovert, et al. (2005) highlighted the stressful nature of electronic performance monitoring in workplaces such as call centres, which tends to increase the workload through the setting of targets and leads to lack of social support as the workers fear engagement in off-task behaviour such as chatting with co-workers. Workers in such situations might also experience conflict between meeting the desire to assist customers and the needs of the system, and this in turn results in experiences of stress (pp. 305-311). Moreover, in education the variable 'type of school' was considered as an important variable that was related significantly to computer anxiety (see, Yang, et al., 1999).

**Personal characteristics:** these included basic characteristics such as age and gender as well as such things as hesitancy, inadequate training, and attitude towards technology/confidence. Some studies about these examples will be described below:

**Age:** A relationship between age and computer anxiety (Dyck and Smither, 1994; Coovert, et al., 2005), and between age and technostress (Clute, 1998) were found, whereas a study conducted by Hudiburg and Necessary in 1996 showed no correlation between age and level of technostress. Also Yang, et al. (1999) found no relationship between computer anxiety and the age of participants.

**Gender:** Men and women showed different levels of computer anxiety (King, et al., 2002; Coovert, et al., 2005), and different levels of technostress (Elder, et al., 1987; Clute, 1998; Voakes, et al., 2003; Ogan and Chung, 2003; Jyh-Rong and Shih-Wen, 2007). Larson, et al. (2002) stated that some studies indicate that gender differences in computer anxiety are abating (p: 129). (See also Whitely, 1996)

**Experience:** Bozionelos (2001) conducted a study to compare computer experience with computer anxiety among three age groups (228 mean age = 32.26, about 67 late 20s, and 220 early 20s). The first group had 10 years' work experience, the second group had eight years' work experience, and the third group were undergraduate students. The results showed that the undergraduate students experienced more computer-related stress than did the other groups. The review study, by Clute (1998) stated that inexperience with computers and lack of training were among the most commonly given reasons for technostress. In their study, Yang, et al., (1999) investigated how computer-related experiences affect the relationship of computer anxiety in vocational-technical teachers. The researchers used the Learning Style Inventory (LSI) and the Computer Anxiety Scale (COMPAS), and the participants were 245 educators. The result showed that "computer-related experience does influence computer anxiety". A study by Ballance and Ballance (1996) on 57 college students used Hudiburg's revised Computer Technology Hassles Scale. The aim was to investigate the incidence of computer-related stress. The findings showed that there were no significant differences between students with a high level of computer skills and students with no or limited computer skills, in reporting computer-related stress. Also, Shepherd (2004) stated that the results of the survey showed a "weak relationship, that as computer skills increased, technostress levels decreased among the three groups [faculty in the colleges of Business and Education and academic librarians]" (p: 230).

**Personality factors:** A study conducted by Hudiburg, et al. (1999) investigated the correlation of personality factor with computer users' stress. The researchers used the questionnaire (Computer Hassles Scale), and 95 students responded to the questionnaire. In general, the findings show a significant correlation between 'Openness' (one of the Big Five personality factors)[2] and computer users' stress. The researchers concluded that personality characteristics affect the stress level of the computer user, and they suggested the need for additional research to clarify the nature of this relationship. Technophobic was another considerable factor in the litterateur as a personal factor. Humphrey (2000) in his study described technophobe as a "person who has some level of discomfort with any kind of newer technology ... they believe something 'bad' is eventually going to happen to them or they may be perceived negatively by peers if they use or misuse technology". In addition Kupersmith, (1992) argued that some individuals are obsessed with computers.

**Perceived control:** In his review, Clute (1998) included some variables that affect the probability of technostress among them was the perceived control.

Results in the studies above showed that some demographic variables (as moderators) and other mediator variables such as experience might or might not affect the probability of technostress. This paradox explains that experiencing technostress depends mainly on the appraisals of the individual. Some other studies reported some mediators such as hesitancy, attitude towards technology/confidence in using technology, and will be described in the following sections:

**Hesitancy:** Weil and Rosen (1997) carried out their study among clerical/support staff, managers, and executives who used technology at work and at home. The study took place over a period of 49 months, and they found that there was a strong

[2] The Big Five personality traits are: Neuroticism, Extraversion, Agreeableness, Conscientiousness, and Openness to Experience. (http://www.wilderdom.com/personality/traits/PersonalityTraitsBig5.html) Last accessed 9 May 2007.

increase in the use of technology at work and at home over that period. According to the study, however, the staff, managers, and executives appeared to be hesitant about using technology. The authors asserted that the "hesitancy reflects the increased stress brought about by technology in our world" (Weil and Rosen, 2000).

**Attitude towards technology/confidence in using technology**: Ballance and Rogers (1991) conducted a study among 186 students undertaking a two-year course at a technical college studying English, Accounting, Electronics, and Business Data Processing. The researchers used the Perceived Stress Scale, the Computer Attitude Scale, and the Computer Technology Hassles Scale. Their aim was to investigate the relationship between attitudes towards computers and computer-related stress. The researchers concluded that there was no significant relationship between academic achievement and stress, attitudes towards computers, or computer hassles. In 1992, Ballance and Ballance conducted another study to investigate computer-related stress among 79 technical college students (23 used computers in their coursework, 32 used computers for reviewing course content, and 24 students did not use them in coursework), using Hudiburg's Computer Technology Hassles Scale. They argued that the computer-related stress was not related to the use of the computers in the classroom, and emphasized the relationship between computer stress and the increased interaction with computer technology. The attitude of teachers towards technology, fear of technology replacing teachers, fear of change (either in the curriculum or ways of teaching), and role of students, especially if students know more than teachers were mentioned in Bai, et al. (2000). In another study in an educational setting, Rovai and Childress (2002) used six self-report questionnaires that included the Computer Anxiety Scale, the Computer Attitude Scale, the Computer Experience Scale, the Computer Knowledge scale, Rotter's Internal-External Control Scale, and the trait form of the Stait-Trait Anxiety Inventory. The results showed that "the best predicators of retained computer anxiety were computer confidence, trait anxiety, computer knowledge, and computer liking, together accounting for 69% of the variance of computer anxiety following completion of a computer literacy course" (p: 226). They suggested that building computer confidence and expanding knowledge would help to treat retained computer anxiety in teacher education students. Wang and Shu (2005) reported five components of technostress. Among them was Techno-insecurity, which refers to technologyinduced job insecurity (such as the fear of being replaced by more skilled people and the constant push to update technical skills) (pp. 78-88).

There is a large body of research on teachers' attitude towards ICT (see for example Knezek, Miyashita and Sakamoto (1993); Smith, et al., (2000); Webb and Cox, (2004); Palaigeorgiou, et al., (2005); Antonietti, and Giorgetti, (2006)). Katz (2002) argued that "research studies have established that psychological attitudes such as independence, creativity, toughmindedness, sociability, risk-taking, stimulus-and sensation-seeking are key attitudes connected with effective ICT use. Teachers characterised by the above psychological attitudes were shown in the research studies to be significantly more amenable to the use of ICT in instruction than teachers not typified by the same attitudinal constructs" (p. 5). Although such studies did not investigate stress, yet as teachers' positive attitudes influence their use of technology, this might play an important role in their experience of stress.

A number of studies investigating attitudes and behaviour have relied on the work of Fishbein and Ajzen (1975) and in particular their theory of planned behaviour. In the theory of planned behaviour Ajzen (2008) stated that "human behaviour is guided by three kinds of considerations: beliefs about the likely outcomes of the behaviour and the evaluations of these outcomes (behavioural beliefs), beliefs about the normative expectations of others and motivation to comply with these expectations (normative beliefs), and beliefs about the presence of factors that may facilitate or impede performance of the behaviour and the perceived power of these factors (control beliefs). In their respective aggregates, behavioural beliefs produce a favourable or unfavourable attitude toward the behaviour; normative beliefs result in perceived social pressure or subjective norm; and control beliefs give rise to perceived behavioural control. In combination, attitude toward the behaviour, subjective norm, and perception of behavioural control lead to the formation of a behavioural intention" (p.1).

Surar et al., (2004) used this theory to examine teachers' beliefs about adopting technology in four schools in the USA. They found that "technology adoption decisions were influenced by teachers' individual attitudes towards technology adoption, which were formed from specific underlying personal beliefs about the consequences of adoption" (p. 201). A study by Ya-Ming (2007) conducted with 242 secondary science teachers in Taiwan, examining the factors that influence the teachers' use of instructional technology showed that the "theory of planned behaviour seriously over simplified the web of forces that influence teachers' use of this technology."(p.425). The author found that the participating teachers' use of technology and their attitude and intention were determined primarily by "the teacher-technology interface (ease-of-use, computer self-efficacy, and perceived usefulness)" (p. 425).

**Causes of technostress and complexity:**

A number of the factors shown in Table 1 can be connected with the concept of 'complexity' – which will be discussed in detail in the following chapter. Several studies identified complexity as an important factor associated with stress, and argued that unpredictability, disruption, multi-tasking, and overload that have been brought about by the presence of technology in our environment can be described as types of complexity. These factors are listed under the headings Job characteristics (b) and (c) in the table above.

## *3.3. Symptoms of technostress*

Symptoms of technostress were categorised by Sanderlin (2004) in the three categories below (slightly modified to fit the terminology used in this thesis):

- Physical symptoms: included increase in heart rate and blood pressure, sweating, dry mouth, difficulty breathing, dizziness, headaches, tingling in the limbs, chest and back pains, sleep disturbances, and irritable bowel symptoms.
- Behavioural symptoms: included loss or gain of weight from not eating enough or overeating, excessive alcohol intake, drug taking, smoking, excitability, restlessness, impaired speech (stuttering), aggression, becoming passive, avoiding stressful situations, isolating oneself from others, becoming immobilized and unable to take action.
- Psychological symptoms: included subjective symptoms such as anxiety, anger, apathy, boredom, depression, frustration, guilt, irritability, moodiness, and loneliness; and cognitive symptoms such as difficulty in concentrating, forgetting deadlines and meetings, and being more sensitive to criticism.

Symptoms of technostress listed in the literature include weakness, eye and respiratory irritation, and memory disturbances (Arnetz and Wiholm, 1997); increasing number of errors and illness (Brod 1982, Clute, 1998); panic, fear, anxiety, feelings of isolation (Clute, 1998); physical problems, visual and musculoskeletal problems, and lack of control (Carayon, et al., 1999); dissatisfaction, depression, hopelessness, and mental fatigue (Hamborg and Grief, 2003). Coovert, et al. (2005) stated that 'electronically monitored worker' reported psychological tension, job boredom, anger, health complaints, fatigue, repetition, and monotony (p. 309-310). Wang and Shu, (2005) argued that Chinese employees often feel frustrated and distressed in their struggle to adapt to rapidly advancing and increasingly complex technology (p. 78).

These are much the same as those listed in the second chapter as symptoms of stress in general, though some may be more common with technology use or commonly viewed as particularly associated with technology. For example people recognise problems while navigating the Internet, and this leads them to experience frustration; difficulties dealing with information overload lead them to experience mental fatigue; and the difficulty of using certain features of technological devices (particularly things like mobile phones or a TVs features) lead people to experience annoyance. Moreover, the overstimulation resulting from technology use might lead to sleeplessness or restlessness. The multitasking often associated with technology use can result in experiencing fatigue or difficulty in concentrating. Losing work, errors, and downloading software are the sorts of technological problems that interrupt people's work and therefore lead them to experience frustration and anger. These kinds of problems and the related symptoms highlight what is different and special about technostress and therefore why it is worth looking at it as a special topic. Some other problems of technology lead to physical symptoms such as eyestrain and injury, though these forms of symptoms will not be considered in this study.

Because of the causes of technostress, individuals use different strategies to cope with it, and researchers suggested some solutions to organisations to overcome some of the reported causes. Coping strategy is important in the 'stress process' (see the second chapter), and some of the coping strategies will by highlighted below.

## 3.4. Coping with technostress

A number of studies have discussed 'coping with technostress'. Some coping strategies were emotion-focused strategies and others were problem-focused strategies. Emotion-focused strategies were such as: 'relax or socialize solution' (Shepherd, 2004); providing psychotherapists, Sanderline (2004) recommended that employers might provide psychotherapy to help technology workers experiencing technostress manage it and think in different ways about technology; Moreover, changing attitudes towards technology was recommended as another solution to reduce technostress. Some studies found a strong link between attitudes to computers and many psychological factors such as interest (Massoud, 1991), utility (Fletcher-Flinn and Suddendorf, 1996), confidence (Rosin and Weil, 1995), and self-efficacy (see Lumpe and Chambers, 2001). Crosby (1979:211) maintained that "people generate problems by their attitude toward their work ... A teacher who devotes himself heart and soul to his work will inevitably experience less stress and greater work satisfaction" (see, Van Der Linde, 2000).

Problem-focused strategies were found in some studies. Training, communication, technical support, practice, reinforcement, appropriate funds for upgrade and repair were found in a range of 58 studies reviewed by Clute (1998). Shepherd (2004) argued that the most commonly reported solutions were to increase knowledge and skills by asking for help, attending training workshops, assuming that effective training and wellness programmes might decrease employees' stress levels and "enhance their sense of technological mastery and personal value". Furthermore, he asserted that employers should provide adequate training for their employees; otherwise they might feel dissatisfied about their jobs due to the increase of error rate and frustration. Training and preparing workers for technology was reported in another study (see Hamborg and Greif, 2003). Support was recommended as another coping strategy (see, for example, Bullinger and Ziegler 1999). It was found that the support of school administrators has an effect on teachers' attitudes towards computers (Bradley and Russell, 1997) and might lead to less computer anxiety (see Kian-Sam and Chee-Kiat, 2002). Coovert, et al. (2005) concluded that human-centred technology design, socio-technical fit, and training - among other factors -

can aim interventions in fruitful directions and help minimize the stressful fallout of technology in the workplace" (p. 319).

## 3.5. The Teacher-Technology Environment Interaction Model

The 'Teacher-Technology Environment Interaction Model' of classroom technostress (T-TE model) (Figure 2) was developed as part of this study in order to describe the nature of stress associated with the use of technology in the classroom. This model draws on both transactional theory (Lazarus and Folkman, 1984) and the P-E fit model (French, et al., 1982) (see Chapter 2), and adapts them for the specific context of teachers working in a technology-rich classroom. This model proposes that a teacher may become stressed when there is a discrepancy between his/her characteristics and the characteristics of the technological environment he/she is working in. The model distinguishes between the objective technological environment (as perceived by an outside observer) and the subjective technological environment (as perceived by the teachers themselves). Similarly the model distinguishes between the objective characteristics of the teacher (as perceived by an outside observer) and the subjective teacher characteristics (as perceived by the teachers themselves). The objective measure of fit (Fo) refers to the relationship between the objective teacher characteristics (To) and the objective technological environment (TEo). The subjective measure of fit (Fs) refers to the relationship between the subjective teacher characteristics (Ts) and the subjective technological environment (TEs).

Lazarus (1966) argued that stress arises from the subjective transaction that is from the way the individual appraises the event, the resources available to deal with it, and ways of coping with it, and his critique of the engineering (environmental) approach to stress led him to downplay the role of objective factors. However some researchers (see, for example, Moos and Swindle, 1990; Costa and McCrae, 1990; Krohne 1990; Perrewe and Zellars, 1999; Schaubroeck, 1999; Frese and Zapf, 1999) have criticised Lazarus for going too far in this direction and stress the objective existence of events and the possibility of measuring them, and they put additional emphasis on how the individual interprets these objective conditions (as in e.g., Perrewe and Zellars, 1999; and Frese and Zapf, 1999). They argued that there are strong constraints on subjective appraisals arising from the objective characteristics of the environment. Objective stressors such as diseases or floods are interpreted by the individual according to the strength, the duration, and other features that make them worse or more dangerous. The proposed model therefore contains an assessment of the fit between the objective teacher variables and the objective environmental variables. The model does not intend to imply that objective misfit alone can lead to stress, and whilst it would only be expected that stress to be experienced when there is a subjective misfit, it is useful to note those situations (if any) where there is an objective misfit together with subjective fit because this may well lead to trouble in the future, as it is possible that the situation will become more severe and the person then changes his/her appraisal.

The thesis considers two forms of fit. The first is the demand and ability (D-A) form and the second is the need and supply (N-S) form. If a teacher is working in a technological environment where there is a good measure of fit both objectively and subjectively, then the model indicates there will be no experience of stress. Two forms of lack of fit can occur:

a) From the perspective of the job-environment's demands, there is the demand and ability (D-A) form, where, for example, the teacher is working in a technological environment that is demanding the exercise of technological skills or abilities not possessed by the teacher. (This lack of fit might occur between either the objective or subjective variables).

b) From the perspective of the employee's needs there is the need and supply (N-S) form, where for example the teacher may need technical support or training to carry out their work effectively, but this is not supplied in the technological environment in which they are working. (This lack of fit might also occur between either the objective or subjective variables).

In these cases the teacher may experience stress. Two other processes play a role in determining whether the teacher actually experiences stress:

- The appraisal process:
    - where the teacher identifies the demands or needs, and whether he/she considers these as a threat to his/her well-being (primary appraisal);

    - where the teacher identifies the resources available (abilities or supplies), and previous experience (reappraisal) - if any -, to meet the situation (secondary appraisal);
- The coping process – the appraisals have prepared the teacher to now use coping techniques, either to deal with the stressors or to deal with the symptoms.

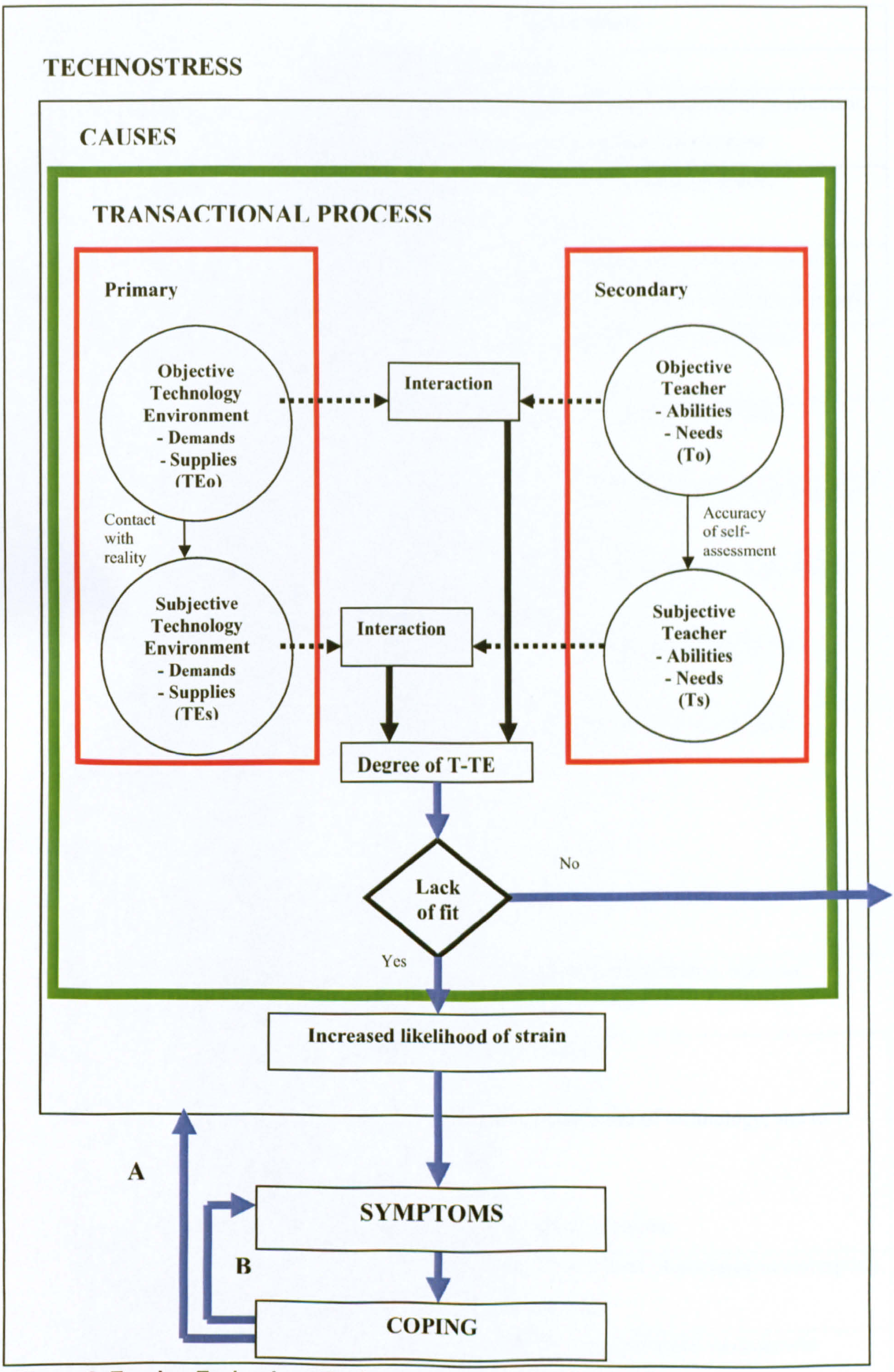


**Figure 2: Teacher-Technology Environment Interaction Model of classroom technostress**

Note: The line A indicates the use of a problem-focused coping strategy, and line B indicates the use of an emotion-focused coping strategy.

| Concept | Explanation |
|---|---|
| Technostress | Stress caused by the use of technology |
| Transactional Process | Stress is conceptualised as the internal representation of problematic transactions between the person and his/her environment |
| Primary appraisal | The teacher's evaluation of an event as stressful, positive, controllable, challenging, or irrelevant |
| Secondary appraisal | The teacher's evaluation of his/her coping resources and options. |
| Symptoms | Psychological, physical, or behavioural responses to technostressors |
| Objective technological environment | The technological environment as perceived by the observer |
| Subjective technological environment | The technological environment as perceived by the teacher |
| Objective teacher | The characteristics of the teacher (e.g., ability, skills, and attitude to technology) as perceived by the observer |
| Subjective teacher | The teacher's perception about his/her characteristics (e.g., ability, skills, and attitude to technology) |
| Demands | Work demands arising from the use of the technology in the classroom |
| Abilities | The teacher's ability to meet the demands of the work situation, including:<br><br>- Skills to teach using technology<br><br>- Ability to prepare and install technology and monitor students' use of technology |
| Needs | The needs that the teacher has in order to be able to function appropriately in the work situation |
| Supplies | Resources such as reliable technology<br><br>Social support to motivate a teacher's use of technology, and to provide help when needed<br><br>Technical support to solve technical problems |
| Accuracy of self-assessment | The degree to which the subjective teacher characteristics correspond to the objective teacher characteristics |
| Contact with reality | The degree to which the subjective technological environment corresponds to the objective technological environment |
| Coping | Strategies used to deal with the causes or with the symptoms associated with technostress |

### *3.6. Conclusion*

Technostress does not differ essentially from other kinds of stress. It potentially has the same effect on individual well-being as other kinds of stress. Technostress has been investigated in workplaces and in education. The overall causes of technostress in the literature are either due to factors related to the job characteristics, factors due to the organisations, and/or factors related to users. The existence of both the personal factors and the environmental factors supports the chances that the psychological approach might be a useful one to use to discuss the technostress - particularly the transactional theory. Also, the nature of the causes encourages to some level, the probability of applying the P-E fit model. The designed 'Teacher-Technology Environment Interaction Model' holding the idea of the transactional theory and the idea of the P-E fit model, and hopefully it will help to investigate the technostress in classroom. Symptoms of technostress such as physical, behavioural, and/or psychological were similar to the normal symptoms of stress and can be measured similarly. In technostress situations, some coping strategies were used such as emotional-focused (e.g., relaxation) or problem-focused (e.g., training) and can be investigated by using a questionnaire or interview. Some causes of technostress 'technostressors' such as work-overload and unpredictability (e.g., unexpected errors) were identified as types of complexity in the workplace. This chapter provides evidence for a probable link between stress, technology, and complexity as some of the factors related to technostress – particularly some factors of the job characteristics – were related to some types of complexity. Therefore, the next chapter will investigate if the complexity is associated with technology related stress.

# Chapter Four

## STRESS AND JOB COMPLEXITY

### 4.1. Introduction

The previous chapter shows some job characteristics that were associated with stress, and that could be described as types of complexity (see section 3.2). This chapter continues to try to address the research question about the causes of technostress, and in order to do so, it is possible to look at a particular set of job characteristics, which can be thought about as aspect of complexity. Therefore, it is useful to look into this concept of complexity in more detail, and to see if there are any insights from the discussion of job complexity in the literature that might be of help in this study. Complexity is often used in a fairly general sense in the literature to refer to 'being made up of many interrelated things' but for others it has a more technical meaning. Hamborg and Greif (2003) and Wang and Shu (2005) identified complexity as an important factor associated with increases in stress levels in individuals. Various studies have argued that technology has increased the level of complexity in our society and workplace. For example, Heylighen (2000) declared that "the explosive development of the Internet and related information and communication technologies has brought into focus ... the growing speed and complexity of developments in society. People find it ever more difficult to cope with ... constant changes in the organizations and technologies they use, and increasingly complex and unpredictable side-effects of their actions. This leads to growing stress and anxiety." Heylighen's observation points to the potential misfit between the individual and his/her complex technological environment, leading to the development of stress.

The focus in this chapter is mainly on the concept of 'job complexity' because this is the aspect that probably has most relevance for the discussion of work-related stress arising from the use of technology.

This chapter will identify aspects of job complexity that may go some way to explaining the stress that arises from the use of technology in classrooms. The chapter consists of three sections. The first section will highlight job complexity, the second section will highlight complexity in the classroom, and the third section will present a conclusion.

## 4.2. Job complexity

The term job complexity is used by different authors to refer to a number of more or less related facets of the job situation. Complexity is associated with 'qualitative over-demand', which refers to "work demands perceived as too difficult to complete satisfactorily" (Blasé, 1986, p. 23); general job characteristics such as variety, significance, autonomy, work load, skill level (Shaw and Gupta, 2004); task identity, and feedback (London and Klimoski, 1975); opportunities for personal responsibility, control, and self-direction at work, (Oldham and Gordon, 1999); degree of demand, challenge, and stimulation (Fried, et al., 2001).

In 1987, Adlemann described some types of occupational characteristics, which he defined as being elements of complexity or control in the workplace, types were such as:

- *Variety* indicates the degree to which an occupation involves a variety of duties characterized by frequent change.
- *Repetition* reflects the extent to which fixed, short-cycle operations are involved.
- *Instruction by others* involves doing work under the close supervision of others, with little allowance for independent action or judgment.
- *Control over self or others* measures the degree of planning and control of one's own activities and those of others.
- *Involvement with data* includes the use of information, knowledge, and conceptions in an occupation.
- *Involvement with people* describes the nature of the worker's relations with others at work and ranges from mentoring, instructing, and negotiating with others to serving other people.
- *Involvement with things* includes contact with machines, tools, and products, and ranges from setting up and working equipment to simply handling objects with little judgment required. (pp. 530, 537).

Items that were categorised under the heading of complexity were 'variety', 'involvement with data' 'repetition' and 'instruction by others', whereas, items such as 'control over self and others', 'involvement with people' and 'involvement with things' were categorised under the heading of control.

The previous chapter discussed some causes of technostress, and some of the causes were characterised under the heading of job characteristics (see section 3.2). A number of these characteristics can be thought of as associated with complexity: too many passwords, information overload, techno-workload, work pace, and change; hardware failure, computer crashes, badly designed software, long response times, uncertainty, disruption, unexpected conflict, and complexity of software and hardware; and multi-tasking. These causes can probably be usefully ascribed to general categories of job complexity found in the literature, namely workload - relating to the number or quality of the tasks to be done; unpredictability - the difficulty of controlling some tasks; and simultaneity - dealing with more than one task at a time. Although other characteristics were discussed in the literature, yet the researcher thinks that these three characteristics were dominant and might be used in this study to act as descriptors of the main types of complexity. More description about these three types will be highlighted below, and having developed a better understanding of these categories, the Conclusion will show how to map the various causes of technostress identified above to these three categories.

### Workload

Workload is a "multidimensional, multifaceted concept" (Korner 2006, p.29). In a simple definition, Jex (1998, p. 15) defined workload as "the amount of work an employee has to do"; it can be quantitative (volume of work one has to do) or qualitative (difficulty of the work). In addition, it can be subjective (perceptions of the work), which can be measured by asking the employees about their perceptions of the level of workload, or objective (the actual work), which can be measured by knowing the hours of work, number of projects, number of clients served, and/or number of products produced (Jex, 1998, pp: 15-16).

Many studies have been conducted to investigate the effect of workload in the workplace, demonstrating the existence of stress related symptoms associated with high workload. For example, Repetti (1993) reported, "On days in which workload was perceived to be high, ATCs [air traffic controllers] reported more health complaints and moods that were more negative and less positive" (p: 123). Furthermore, a relationship was found between blood pressure and workload among air-traffic controllers (see, Cobb and Rose, 1973). Goldberger and Breznitz (1993) stated that high blood pressure and pulse rate were reported "during the more demanding periods of a paramedic's workday" (pp. 374-5). Workload was also found to be associated significantly with hypertension (see House, 1984; Arnetz and Wiholm, 1997; Sanderlin, 2004). Some studies reported a "significant positive correlation of excessive workload and work-related interpersonal conflicts with anxiety, frustration, job dissatisfaction, and health symptoms" (see Spielberger and Reheiser, 1995, p. 54).

The problem of workload relates to people's limited amount of resources to deal with such tasks. If there were other tasks added to the individual, then either the resources would be divided or they might be insufficient to manage these tasks. Therefore, as a result, the person would withdraw or would lodge health complaints (see, Staal, 2004). Some studies consider the solution to be in the hands of the workers, and observed low stress levels among participants who used a stress management programme (see, for example, Arnetz and Wiholm, 1997).

### Unpredictability

Some researchers have separated 'control' from 'complexity', but in this study they have been related to complexity because 'unpredictability' has been considered as an important type of complexity – as we will explain below - also clearly unpredictable events cannot be controlled. In some workplaces an individual feels that as he/she cannot predict, so he/she will not be able to control, thus this will be perceived by the individual as to be difficult to deal with satisfactorily. Very few studies have discussed the issue of unpredictability, and the only way the researcher could get hold of, in order to explain it, was through looking at the issue of 'control'. There are two kinds of control issues. There are those to do with the fact that someone does not have control over their work because someone else controls it, and those who do not have control over their work because their work is unpredictable. The first type of control issue (where someone else tells you what to do) is probably not associated with complexity (it may make the job stressful, but it makes it simple, not complex). The second type of control issue (unpredictability) is associated with complexity and potentially with stress. In this thesis, the second aspect of control – i.e., 'unpredictability' will be used.

It was found that people find it stressful when they "lack a sense of control" (Jex, 1998, p. 20). In a study conducted by Katz and Wykes (1985), which tested the hypothesis that "predictable aversive events are more beneficial than unpredictable ones," the participants were 80 females, who received six predictable and six unpredictable shock trials. The findings showed that the participants "reported to have felt less distress during the interval before the predictable shocks, [and] they perceived the predictable shocks to be less aversive than the unpredictable ones" (p. 781). Staal (2004) claimed, "the more a situation or stressor is perceived as [being] within one's control, the less stress provoking it appears to be. Similarly, the more predictable a negative event or set of circumstances is, the less distress it causes" (p. 25).

Control has been defined as "the belief that one has at one's disposal a response that can influence the aversiveness of an event" (Thompson, 1981, p.89). Thompson, (1981) discussed a fourfold typology of control: "(1) *Behavioural control*; is defined as a belief that one has a behavioural response available that can affect the aversiveness of an event. (2) *Cognitive control;* is the belief that one has a cognitive strategy available that can affect the aversiveness of an event. *(3) Information control;* refers to a communication delivered to a person who is a potential recipient of an aversive event. [According to Thompson these three types of control usually refer to people's beliefs about control as they undergo potentially stressful events.] *(4) Retrospective control* refers to beliefs about the causes of a past event. The issue here is not feelings of control while experiencing an event but attributions about the cause of the event once it has happened" (pp. 90-91). It has also been reported that "Control (variously conceptualized as autonomy, responsibility, decision latitude, and supervisory status) has ... been found to have a positive association with job satisfaction" (Adelmann, 1987, p. 529).
In a technological workplace, the inability of the worker to control technology breakdowns or malfunctions, inadequacies, and changes might result in stress or

frustration. For example, Coovert and Thompson (2003) claimed that lack of control was the main predictor of job dissatisfaction for the first few years following the introduction of technology (pp. 228-229).

### Simultaneity

Whether or not doing more than one task at the same time causes stress may depend on the nature of the tasks. It was reported by some studies that simple and similar tasks performed in everyday life are believed to be managed and dealt with more readily because the attention (focus) can be easily divided between them (see, for example, Eysenck and Keane, 2000). Examples of such tasks would be driving and talking and watching TV and talking. In addition, such studies found that tasks with a similar stimulus modality (e.g., visual) need the same processing and might need the same response (see Bonnel and Hafter, 1998; and Eysenck and Keane, 2000). However, this is not true for some tasks, for example, reading a book while driving a car, which is harder than driving and listening to the book on a tape (see, for example, Korner 2006). Maybe when conducting a single task is much easier because it can be treated with full focus and given complete rather than divided attention. Studies were conducted to investigate performances when conducting two difficult tasks, some studies reported that other variables emerged such as coordination and avoidance of interference when conducting two tasks. If there was any interference, poor performance was noticed (Eysenck and Keane, 2000). Generally, people face difficulty when conducting more than one task at the same time because of their limited resources, Korner (2006) made this point clearly when she stated that "the limits of divided attention sometimes refer to our limited ability to time-share the performance of two or more concurrent tasks, and sometimes refer to the limits in integrating multiple information sources" (p. 15), this sometimes resulted in stress (Weil and Rosen, 1997).

### Measuring job complexity

Complexity in some studies was measured using the measure devised by Semmer and Dunckel (1991), which is composed of four Likert items to find the difficulty of a task (which they do link it to complexity) in the workplace, for example, 'Do you get special tasks that are unusual and exceptionally difficult?' (Speier and Frese, 1997, p. 178). Many studies about job complexity have used the characteristics of the job to indicate its complexity, and some of these studies have used the complexity job scale or the Dictionary of Occupational Titles (DOT) scale to test the complexity of a job. This scale is a "summary indicator of eight key characteristics, which Roos and Treiman (1980) summarized as follows: (1) Complexity of the function in relation to data, (2) General educational development, (3) Specific vocational preparation, (4) Intelligence, (5) Verbal aptitude, (6) Numerical aptitude, (7) Abstract and creative versus routine, concrete activities, (8) Repetitive or continuous processes" (cited in Xie and Johns, 1995, p. 1293). Some studies have designed different questionnaires to test job complexity (see, for example, Shaw and Gupta, 2004).

### Job complexity and symptoms

The concept of job complexity is the central "concept in the work-stress literature ... that it exhibits power relationship with strain outcomes...and is among the strongest psychosocial predictors of physical health outcomes" (Shaw and Gupta, 2004, p. 894). Job complexity was found to be related positively to individuals' wellbeing - as this will be described in more detail below - (Grebner, et al., 2003), to behavioural and attitudinal outcomes (Fried, et., al. 2001), and to job satisfaction (Blasé, 1986; Adelmann, 1987; Sharif, 2000). Some of the studies that investigated complexity in the workplace and showed a relationship between job complexity and physical, behavioural, and psychological symptoms will be highlighted below.

**Job Complexity and physical symptoms:** Melamed et al. (2001) conducted a longitudinal study on 870 workers to investigate the effect of chronic exposure to noise and job complexity on change in blood pressure (BP) and job satisfaction. The method they used to measure job complexity was to assess two items, task complexity and task variety. The first was provided by assessing the number of elements, decisions, skill level, independence, and sophistication of the employee's job. The rating of the first item ranged from 1= very simple job to 4= very complex job. The second item was assessed using the 'diversity of tasks in a given job', and the ratings ranged from 1= no diversity to 4=high diversity. The results showed that workers who performed complex jobs and were exposed to high ambient noise levels, showed threefold increase in systolic BP and twofold increase in diastolic BP compared with workers who performed simple jobs (Melamed, et al., 2001). Workers have also been found to complain about headaches and stomach pains due to work complexity (Goldberger and Breznitz, 1993).

**Job Complexity and behavioural symptoms:** Goldberger and Breznitz (1993) stated that complexity in the workplace, particularly increase in workload, leads to increased smoking. Also it was reported that complexity "create[s] a continuous source of tension which can, in turn, lead to violence" in the workplace (Sharif, 2000, p. 108). It was stated that difficulty to deal with complexity at workplace might lead workers to withdraw from work (Staal, 2004).

**Job complexity and psychological symptoms:** Sonnentag et al. (1994) conducted a study on 180 software professionals using the scale developed by Semmer and Dunckel (1991) to measure work complexity to investigate the relationship between stressors and burnout experience. The findings showed that lack of identification corresponding to low personal accomplishment and emotional exhaustion was related to control at work, complexity at work, and openness to criticism within the team. In a study in 1987, Adlemann concluded that the occupational characteristics of control, complexity, and personal income were related to the psychological well-being of both women and men employees.

Some factors of job characteristics were attributed to types of complexity and were used to describe the job complexity in both normal workplace environments (see, Xie and Johns, 1995) and technological environments (see, for example, Coovert and Thompson, 2003). The next section will look at the factors associated with complexity in the classroom.

## *4.3. Complexity in the classroom*

I will start this section by quoting the scientist, Albert Einstein, who said, "space is not merely a background for events." This quotation was also used by Doyle (1977, p. 51), one of the authors who emphasises the importance of understanding the complexity of the classroom environment, claiming the role of understanding complexity in the "effective promotion of teaching and learning" (see Simco, 1995, p. 50). Doyle argued that "classroom knowledge is the core foundation for teacher research and practice" (Doyle, 1990b, p. 347). In this way, Doyle and others suggest that good understanding and "quality management of [complexity in the] classroom environment is associated with achievement" (Doyle, 1981, p. 5). Many other researchers emphasise the importance of acknowledging the classroom environment (see, e.g., Kounin, 1977; Brophy, 1979; and Good, 1979). If this is the case, what is the complexity of the classroom environment that should be understood?

The ecological approach to the classroom seems to be very important here because it "acknowledges the classroom as profoundly complex human environments" (Simco, 1995, p. 50). The ecology model contains three basic dimensions. The first is the ***naturalistic*** dimension, which "sees classrooms as richly detailed and intensely complex," (Simco, 1995, p. 50). The second is the ***environment-behaviour relationship,*** which means that the "observed behaviour is in a large measure a response to the demand characteristics of a given setting" (Doyle, 1979a, p. 189); and the third is the ***functional value or adaptive significance of behaviours in an environment,*** which deals with the question "why do teachers and students behave as they do in classrooms?" (Doyle, 1979a, p.189). The focus in this study is on the first dimension, '***naturalistic***', because classrooms in this respect are seen as "having attributes of multidimensionality, simultaneity, and unpredictability [which] express further the complexity of the classroom environment" (Simco, 1995, p. 50). In his account of one of his earlier studies, Doyle defined these terms in the following way:

- **Multidimensionality** refers to "the large quantity of events and tasks in classrooms." He claimed, "A classroom is a crowded place in which many people with different preferences and abilities must use a restricted supply of resources to accomplish a broad range of social and personal objectives."
- **Simultaneity** refers to "the fact that many things happen at once in classrooms." For example, Doyle stated, "While helping an individual student during seatwork, a teacher must monitor the rest of the class, acknowledge other requests for assistance, handle interruption, and keep track of time."
- **Unpredictability** "refers to the fact that classroom events often take unexpected turns." Distraction and interruptions are frequent; "teachers often found it difficult to predict students' reactions to a set of materials or to judge how much time it would take to complete an activity, [and] they were also

frequently frustrated by changes in the normal schedule, breakdowns in equipment, and interruptions." (Doyle, 1986, pp. 394-395)

Many researchers have given different descriptions of classroom complexity. For example, in a study in 1968, Jackson analysed interviews with 50 teachers about the life in the classroom; the analysis indicated four themes related to complexity: immediacy, informality, autonomy, and individuality (Jackson, 1968, p: 119-133). Ebbutt, et al., (2000) described the classroom as a world of little choice or control over the pacing, prioritising, the variability, and the outcomes of immediate events (p. 329). Nias (1989) described the classroom as unexpectedly demanding, shifting, and elusive (p.194). Woods (1986) argued that the teacher finds it difficult to make a decision due to the nature of life in the classroom that discourages doubt and uncertainty, and because the teacher as a human being cannot attend to many things at one time (found in Fisher, 2001).

Other studies that have discussed education and complexity have looked at issues such as the complexity of the learning process, the teaching process from the students' point of view, the complexity of the change, and complexity and the curriculum (see, for example, Jarvela and Niemivirta, 1999; Daley, et al., 2001; Jacobsen, et al., 2001; Sinclair, 2003), and complexity and management either for head-teachers or teachers (see, for example, Doyle, 1980; Copeland, et al., 1994; Sabers, et al., 1991; and Blix, et al., 1994). An example of a study of management in the classroom that relates to some aspects of classroom complexity is a study by Tikunoff and Ward that used observation to investigate events that disrupt the classroom. Their findings showed that the disruptions occurred regularly and sometimes at a rate of one per minute; for example, a student asking for a pencil or an eraser. It was observed that teachers were using different kinds of techniques to cope with the disruptions according to their management styles; also, the researchers provided feedback to the teachers involved in the study and provided them with some techniques, for example, providing additional pencils and erasers in the classroom (Tikunoff and Ward, 1983 p.458).

A number of studies have looked at issues to do with complexity in the technological classroom, for example, Rasmussen and Mathiasen (2004) described four factors, reported by teachers, that contributed to the increase in complexity i.e. multitude of tasks; time needed to deal with quick changes of demands; continuous flow of demands and tasks; and school management and changed forms of teacher cooperation (p. 2). Moreover, Rasmussen and Mathiasen stated that the use of the laptop computers in teaching resulted in complexity caused by individual learners working on their own machines, the potential causes of distraction arising from this, and the relationship of this to overall classroom control. Sandholtz, et al., (1997) stated that technology "added yet another layer of complexity, a whole new set of things for already overworked and stressed teachers to learn and manage" (p. 36), and suggested that researchers could apply the first four features of classroom complexity as described by Doyle to the technology-rich classroom:

- Multi-dimensionality refers to the large quantity of events and tasks in the classroom and with the addition of technology and a shift to constructivist teaching, the number of events and tasks increases almost exponentially.
- Simultaneity refers to the concurrent events in the classroom. It increases significantly as students work individually or in small groups on computers. Moreover, students often are working on different tasks, requiring the teacher to monitor numerous activities at once.
- Immediacy refers to the pace of the classroom, which often becomes even more rapid in the technology-rich classroom, requiring immediate action on the part of the teachers.
- Unpredictability is the intrinsic feature that most alters teaching when using technology. The changes in the classroom environment brought about by the addition of technology lead to an even higher level of unpredictability (Sandholtz, et al., 1997, p. 73).

## 4.4. Conclusion

In studies of job complexity, factors relating to complexity have broadly been classified under the headings of workload, unpredictability, and simultaneity. Workload refers to the amount of tasks that employees have to do, and is seen as a multidimensional, and multifaceted concept.

Studies of complexity in the classroom broadly support the categorisation of factors associated with complexity. Commonly the factors were classified under the headings of multidimensionality, unpredictability, and simultaneity. Multidimensionality refers to the large quantity of events and tasks in the classroom that teachers have to do, and so in this study this factor of multidimensionality will be incorporated under the general heading of workload. Studies of classroom complexity also identified the factor of 'immediacy' referring to the immediate action required from teachers in order to deal with rapid pace of classroom events (see Doyle, 1986, and Sandholtz, et al., 1997). Such events that need immediate action are unpredictable and cannot be controlled, and so this factor of 'immediacy' in this study will be incorporated under the general heading of unpredictability.

Accordingly, in this study the factors associated with job complexity in technological classrooms will be classified under the three headings of workload, unpredictability, and simultaneity.

These three categories then give us a useful way of thinking about the range of job characteristics that were identified in Chapter 3 as *Job characteristics b) Technological characteristic (Performance); and c) Technological characteristic (impact on user)*. These characteristics were:

B:

- Too many passwords, hardware failure, computer crashes
- Badly designed software
- Long response times

C:

- Information overload
- Uncertainty (constant changes in computer hardware and software)
- Disruption
- Multi-tasking (manage too much at the same time)
- Workload (quantity of work to be done)
- Work pace (faster work speed)
- Conflict (conflict with worker's desire to provide quality customer service, and conflict with management's demands for quality)
- Change (change of work habits caused by new technology)
- Complexity (the inability to learn or deal with the complexity of new technology)

And these factors will be classified under the headings of *workload*, referring to the quality and quantity of events and tasks; *unpredictability*, referring to unexpected and uncontrollable events; and *simultaneity,* referring to managing more than one task at the same time. Accordingly, the factors in B and C above would be classified in the following way:

### Workload

Quantity of work (the concept of workload in Chapter 3 refers principally to the 'quantity' of work, whereas the category of 'workload' here is somewhat broader), work pace, change (as this means that the employee has to get additional training), information overload, and things like 'too many passwords'.

### Unpredictability

Hardware failure, computer crashes, badly designed software, long response times, uncertainty, and disruption. In this category of 'unpredictability' things which are related to issues to do with control will be included. In particular, the concept of 'conflict' from Chapter 3 that is issues arising from loss of control due to monitoring of work flow, or from unclear role changes arising from the use of technology, will be included. Moreover the concept of 'complexity' of software and hardware will be included, as the difficulty of dealing with them and/or learning about them leads to 'no control over work'

### Simultaneity

Multi-tasking, that is manage many tasks at the same time.

This construction of complexity as made up of workload, unpredictability and simultaneity gives us an approach to analysing job characteristics that promises to provide useful insights into the specific relationship of technology to stress because technology can be seen to have clear and close connections to precisely these aspects of job complexity.

# Chapter Five

## RESEARCH DESIGN

### 5.1. Introduction

The literature suggests that technostress exists in the workplace due to the changes of the characteristics of the job brought about by technology. There is relatively little literature investigating technostress in technological classrooms. This study investigates the existence of technostress and provides a description of technostress in technological classrooms; furthermore, it identifies aspects of job complexity that may be associated with this technostress. This chapter explores issues related to the design of the empirical study. There is no single agreed methodology for measuring stress, though there is agreement about the value of using several methods such as questionnaires, interviews, observations and biofeedback (such as blood pressure, Galvanic Skin Resistance - GSR) in the same study. Because of the uncertainties about the appropriate methodology, some preliminary studies were carried out in order to gain more knowledge and experiences that might help the researcher to better frame the research questions and select appropriate methods.

The design of the study was as follows:

a) 14 institutions were involved in the survey (five secondary schools, five primary schools and four CLCs). 20-30 questionnaires were handed to each of the secondary and primary schools, and 5-10 questionnaires were handed to the CLCs. The number of questionnaires returned was 136, of which 119 were regarded as completed, and the others were ignored because they were not fully answered.
b) Nine teachers participated in the classroom investigation, GSR readings were taken for all the teachers during the classroom sessions, and they were observed and interviewed. All interviews and observations data were analysed and is reported here, but as far as the GSR data is concerned some examples were highlighted in this account, but a full analysis of all of the GSR readings was not carried out..

c) Four case studies were created. These case studies were selected according to the categories that were determined from the previous analysis of the survey data.

   a. Age 35 or under, holds positive attitude, and uses technology a lot (4 teachers);
   b. Age 36 or more, holds positive attitude, and uses technology a lot (1 teacher);
   c. Age 35 or under, holds negative attitude, and does not use technology a lot (3 teachers);
   d. Age 36 or more, holds negative attitude, and does not use technology a lot (1 teacher).

   A case study was created for one teacher chosen to represent each of these groups.

This chapter consists of six parts. The first part describes the initial studies; the second part is about the research questions; the third part describes the research approach; the fourth part discusses the survey method; the fifth part is about the classroom investigation method; and the sixth part discusses the ethical issues.

## *5.2. Preliminary Studies*

Researchers will particularly lack knowledge about their study where (a) they are researching a new subject never investigated before (b) there is a lack of references, where the subject was previously studied by just a few researchers or (c) the researcher is new to the area or the field he/she is aiming to conduct his/her study in. Condition (c) applies to this study. In these circumstances, Barker et al. (1994) recommend that researchers should conduct simple descriptive studies in the area before conducting the main study. These studies should help the researcher to become more knowledgeable about the problem, the main variables, and the methodology that he/she will use for the main study.

First, a small-scale study was carried out with the prime objective to discover if it is indeed possible to conduct a study in this area, and to gather various viewpoints about stress as it relates to technology use. The main items within the questionnaire were: (1) To what extent are the participants using technology? (2) How do they feel about the use of technology? (3) Do they experience stress as a result of using technology and, if so, what is the nature of the stress? This open-ended questionnaire (see Appendix A) was distributed to some staff and students (some of them teachers) at the Institute of Education. Out of 100 questionnaires distributed, 36 responses were returned; however, 5 were ignored because they were not fully completed. Following the coding of the responses to the open-ended questions, the Statistical Package for the Social Sciences (SPSS) was used to help analyse the data. The findings based on 31 respondents were:

1- All the respondents used a variety of technologies, and 77% of them used computers frequently.
2- 54% of the respondents thought that technologies decreased stress in their lives and 38% thought technologies increased stress.
3- 48% of the respondents thought that technologies decreased complexity in their lives and 35% thought technologies increased complexity.
4- 38% thought that the most important factor that might cause stress is when technology does not work, and 19% thought that another factor was feelings of frustration with the Internet and computer.
5- 41% thought that technologies saved time, and the same percentage thought they were good for management.
6- 22% thought that learning new ICT caused complexity (difficulty) in their lives.
7- 25% thought that communication was possible and easy by ICT; therefore, participants thought that technologies reduced complexity in their lives.
8- Using ICT (just have to get on with it) or leaving ICT (sometimes try to get away from technology) were the main coping strategies used to deal with stress and complexity caused by ICT.

This first questionnaire showed the researcher that it is possible to conduct a study about technostress in education, and the viewpoints of the participants were important. Although only a minority saw technology as stressful, it was nevertheless a large group; therefore, a second questionnaire was designed to gain more information about the association between stress and the use of technology. The second questionnaire (see Appendix B) was reviewed by colleagues at the Institute of Education who made suggestions that were incorporated in the redesign. The questionnaire consisted of 28 elements. Of 155 questionnaires distributed to students (some of them were teachers) at the Institute of Education, 106 were returned. Two were ignored because they were incomplete, leaving 104 of which 38 were male and 66 female. The data was analysed with the aid of SPSS to generate descriptive statistics and to examine the correlations that exist between the variables. The study focussed on three main issues:

1. Determining the symptoms that were experienced by the users of technology and to get information on this, symptoms derived from the literature review were listed in the questionnaire.
2. Determining the factors that were related to technostress that is, the causes of technology-related stress, causes derived from the literature review were listed in the questionnaire.
3. Determining whether there were any associations between stress due to technology and the factors of age, gender, and attitudes towards technology.

One of the findings of this preliminary survey was that some participants reported that they experienced health problems when they used technological devices. Participants reported different symptoms, as indicated in Table 2. About 54% of the participants experienced mental fatigue (a psychological symptom), while 50% experienced headaches (a physical symptom), and 49% exhibited a bad temper (a psychological symptom). Muscle tension was another physical symptom, reported by 38% of the participants, and 'inability to concentrate' (a psychological symptom) was reported by 37% of the participants. The results here are different from those in the first survey, which used open-ended questions. The questions in the present survey proposed some possible causes and symptoms, and it is therefore possible that this biased the participants towards accepting them.

| Symptoms | Frequency | Percentage % |
|---|---|---|
| Mental fatigue | 56 | 54 |
| Headaches | 52 | 50 |
| Bad temper | 51 | 49 |
| Muscle tension | 40 | 38 |
| Inability to concentrate | 39 | 37 |
| **Total** | **104 students** | **100** |

**Table 2: Symptoms experienced by the users of technology**

The above table illustrates the main physical and psychological symptoms that were reported by participants when they used technology. Mental fatigue, headaches, bad temper, muscle tension, and inability to concentrate were the most commonly reported symptoms amongst the 12 symptoms listed in the questionnaire.

Another finding of the study was about the association between stress due to technology and the factors of age, gender and attitude to technology. The hypotheses that there might be relationships between these factors and symptoms of technostress were investigated by looking at the reported occurrences of stress-related symptoms and these factors, but no evidence of a significance relationship was found. For example:

- 58% of males (22 of 38 male students) said they experienced mental fatigue, whereas 52% of females (34 of 66 female students) said they experienced it. This relationship was not statistically significant (chi-square value = 0.395, degree of freedom =1, $p>0.05$). 45% of males said they experienced headaches, whereas 53% of females said they experienced headaches, but this relationship again was not statistically significant. The examples were the two most commonly reported symptoms of stress.
- Among respondents aged 18-25 (29 of 51 students), 57% said they experienced mental fatigue, whereas 49% of those aged 26-35 (19 of 39 students) said they experienced mental fatigue, and 62% of those aged 36-50 (8 of 13 students) said they experience mental fatigue (see Table 3), but this relationship was not statistically significant.

| | | Age of the respondents | | | Total |
|---|---|---|---|---|---|
| | | 18-25 | 26-35 | 36-50 | |
| Mental fatigue | Yes | 57% | 49% | 62% | 54% |
| | No | 43% | 51% | 38% | 46% |
| **Total** | | **100.0%** | **100.0%** | **100%** | **100%** |

**Table 3: Cognitive symptoms of mental fatigue and age of the respondents**

- It was also found that there was no statistically significant relationship between participants' attitudes towards technology and mental fatigue as a result of using technology. Among respondents who said they avoid technology, more than 66% said they experience mental fatigue, whereas about 47% of those who 'love' using technology said they experienced mental fatigue, and 59% of those who do not 'love' using technology but have to use it reported that they experienced mental fatigue.

45% of respondents reported that information overload was one of the most important factors that caused technostress, whereas 49% agreed to some degree that 'technology errors' was the most important factor that caused technostress, and 39% thought that security issues were one of the main causes of technostress. 49% of the participants supported to some degree the proposition that the complexity of life increased because of technology, and 22% strongly supported it. In addition, about 32% supported to some degree the proposition that current technological devices were more complicated than old technological tools, whereas about 33% strongly supported it (see Tables 4 and 5).

| **Complexity of life increases because of technology** | | **Frequency** | **Percent %** |
|---|---|---|---|
| | Strongly support | 23 | 22 |
| | Somewhat support | 51 | 49 |
| | Somewhat oppose | 16 | 15 |
| | Strongly oppose | 10 | 10 |
| | Don't know | 4 | 4 |
| | **Total** | **104** | **100.0** |

**Table 4: Complexity of life increases because of technology**

| New technological devices are more complicated than old tools | | Frequency | Percent % |
|---|---|---|---|
| | Strongly support | 34 | 33 |
| | Somewhat support | 33 | 32 |
| | Somewhat oppose | 22 | 21 |
| | Strongly oppose | 10 | 10 |
| | Don't know | 5 | 5 |
| | **Total** | **104** | **100.0** |

**Table 5: New technological devices are more complicated than old tools**

The final part of the questionnaire considers the participants' expectations about the future of technology. About 62% of the participants thought that they will not be able to control the changes that occur in technology in the coming years, 62% of them thought that technology will make the future more complicated, 48% think technology will increase stress in the future, and 60% expected to have less free time (see Table 6).

| Feelings about the future | Frequency | Percent% |
|---|---|---|
| Will not control change of technology in the future | 65 | 62 |
| Less free time in the future because of technology | 62 | 60 |
| Technology will increase stress in the future | 50 | 48 |
| Life will be more complicated in the future because of technology | 65 | 62 |
| **Total** | **104** | **100.0** |

**Table 6: The expectations of students about the future of technology, sample of (104) students**

The third step in the preliminary study was a series of interviews. For this the researcher chose to interview 11 practising teachers rather than the Institute of Education students, in order to better catch the mood of the classroom. The interview consisted of one prompt question to give the teacher the opportunity to talk about his/her experiences and feelings when using technology in the classroom. The question was: "Do you think that using technology in the classroom will make your teaching stressful? Why?" Teachers' responses to the question were tape-recorded and then transcribed (see Appendix C).

A thematic analysis of the interview responses found the following themes:

USE OF TECHNOLOGY IS NOT STRESSFUL

- Some teachers reported that they have not experienced any technostress.
- Technology could help to reduce stress sometimes in the classroom.

USE OF TECHNOLOGY IS STRESSFUL

- Sometimes technology makes teachers annoyed, so they get stressed.
- Learning about using technology causes stress.
- Preparing technology for the classroom is much more stressful than preparing for classes that do not use technology.

FIT FOR PURPOSE

- If technology does not deliver the job the teachers want, then they will experience stress.
- How technology is used in the classroom is important. For example, one teacher said that using it as fun and as a learning game will not cause teachers any stress since they are helping students to play and learn.

TRAINING

- Knowing how to use technology in the classroom will make it easy and reduce stress.
- Levels of technological knowledge are important, and if teachers are uncertain about technology, then his/her situation will be stressful.
- Preparing the session and practising it before delivering it to the students, helps teachers to get used to the technology, therefore helping him/her not to get stressed.

TECHNOLOGY PROBLEMS

- Technology does cause stress if it does not work properly.
- Trying to find out what was the problem in the software or with the computer for the student and attempting to solve it, causes stress to them.
- Teachers should not rely too much on technology because it might not work and thus cause them stress.

This interview data with 11 participants will not form part of the study reported in the following chapters (6, 7), and the categories used here will not be used later; however the development of these categories did help in the final development of the categories that will be used in the analyses of the interviews in the classroom investigation.

The previous sections have described the preliminary studies that were conducted using both questionnaires and interviews. The researcher used an open-ended questionnaire first because there was little idea what sort of answers would be gotten, but an open-ended questionnaire takes a lot of work to analyse. Once the researcher had some idea of the sorts of answers participants would give, then a mainly closed questionnaire was constructed as this would be much easier to analyse for large numbers of respondents – though some open-ended questions were incorporated in order to capture the differences and opinions that closed questions cannot capture. The second survey tried to clarify the concept of technostress to the participants by listing possible causes and symptoms from which to choose. The differences in the responses between the initial survey with open-ended questions and the survey using more closed questions were clear, as shown above. The interview allowed the researcher to discuss the issue of technostress with the participants and tended to overcome the limitations of the lists in the questionnaire, as teachers added some of their experiences. The questionnaire was also modified with the addition of some questions related to teacher characteristics; and the reasons for this will be discussed later. Some other questions - such as questions about future use of technology - were deleted due to the length of the questionnaire. The results showed that the participants reported the same causes and symptoms as described in the current literature, and no new ones were added by them. In general, the findings indicated that these methods yielded potentially useful results, and therefore would be usable and have value for the main study. The literature suggested that such methods should be supported with observation method and/or biofeedback measures. The observation method was not trailed because of lack of time, while the GSR was trailed with some friends in the Institute of Education but not in classrooms with teachers.

## *5.3. Research Questions*

The issue of stress emanating from technological environments in the classroom is a contemporary issue, less researched than other sources of stress for teachers. The researcher is aware that stress is difficult to measure as there are many moderators and mediators that influence individual's experiences of stress. In addition, the literature showed that individual's characteristics, beliefs, attitude, confidence, experience, and so on play an important role when reporting stress. This study will exclude participants with high scores on general measures of stress, as high levels of general stress will mean that it is impossible to detect any impact of technology on stress for these people.

So what are the aims of this study and how could such aims be represented in sub-questions.

***The aims of this study are:***

***1- To determine whether there is a relationship between technology use and teacher stress in the classroom, and if so then***

***2- To identify the key factors that influence teachers' stress in a technology-rich classroom environment.***

***3- To identify the nature of the relationship between technology use and teacher stress in the technology-rich classroom, and then determine to what degree does the Teacher-Technology Environment Interaction Model of classroom technostress provide an adequate model of this relationship?***

**The main research questions are:**

<u>Aim 1:</u> ***To determine whether there is a relationship between technology use and teacher stress in the technology-rich classroom.***

Is there a relationship between technology use and teacher stress in the technology-rich classroom?

- Do teachers report that the use of technology causes stress?
- Can evidence for this be found in classrooms?

Does increased use of technology result in increased stress?

Is there an association between the attitude towards technology and the individual's report of experiencing technostress?

Is this experience of technostress associated with age, gender, type of school, attitude, and amount of use of technology?

Aim 2: *To identify the key factors that influence teachers' stress in the technology-rich classroom.*

What are the main stressors associated with technostress?

- What do teachers report as the main causes of technostress?
- What are found to be causes of technostress in the classroom?
- To what extent can we relate causes to forms of job complexity?

What are the chief symptoms of technostress?

- What do teachers report as the consequences of stress experienced whilst using technology in the classroom (symptoms of technostress)?
- What are found to be symptoms of stress in the classroom?

What are the coping strategies that teachers use to deal with technostress?

- What are the reported strategies they use to deal with this stress (coping strategies for technostress)?
- What are found to be coping strategies used in the classroom?

Aim 3: ***To identify the nature of the relationship between technology use and teacher stress in the technology-rich classroom, and determine to what degree the Teacher-Technology Environment Interaction Model of classroom technostress provides an adequate model of this relationship***

What is the nature of the relationship between technology use and technostress? Is this a relationship mediated by the personal understandings of the teacher and, if so, in what ways?

Does the T-Te model provide an adequate model of this interaction?

The following sections outline the research methods that will be used to attempt to answer these questions.

## 5.4. Research Methodology and Methods

This study uses a combination of methods, bringing together both qualitative and quantitative data, in order to better understand technostress in the classroom. It uses a survey with one reasonably large group of respondents, and a variety of methods of capturing what goes on in the classroom (observation, GSR, and interview) with a much smaller group of participants. The survey is used to find out if there was any technostress in classroom environment (i.e., establishing the existence of technostress and teachers' views about it), then the classroom investigation helps the researcher to understand more about what this technostress looks like in practice (i.e., describing technostress). Where the various methods of data capture overlap, this may help to decrease the incidence of subjectivity in this study (as suggested by Creswell, 2003, amongst others). This combination of survey-based data and interview and observational data is often seen in psychology and in the field of human-computer interaction. Video recording and diaries are used particularly in studies that investigate the relationship between the use of computer, stress, and health in work-place (see, for example, Aborg, 2002). Because the topic is new and has been rarely addressed (Creswell, 2003, p: 22) – often considered an important reason to use a qualitative approach - therefore, more attention is paid to working with qualitative approaches and less with the quantitative approaches in this study.

The questionnaire will be used to collect data about teachers' perceptions of stress. This method has been used in the preliminary studies and indicated that it might have value for the main study. The GSR counter will be used as a means of recording of the changes in the skin conductivity - this method was recommended by Wilson (2002) and Prendinger et al., (2005). Observing and video-recording the teacher during the whole session will yield some data about events related to the use of the technology, and teachers' behaviours when dealing with it. Some events observed in the classroom might be related to changes in the GSR, and this can be compared with the data from the other two methods (observation and interview), as the researcher is aware that some changes in the GSR counter are not necessarily due to stress. The teachers will be interviewed, asked about their perception of the events and how do they deal with them; this hopefully will give a clearer view of what is happening. During the observation a video camera will be used to record each session, and a later playing back of the tapes might allow the researcher to observe events and behaviours in more detail. This method was used in other studies such as Sabers, et al., (1991) and Mandinach and Cline (1994).

Table 7 shows the research questions and the research methods, which then shows how the researcher maps the method's results to research questions

| Questions | Methods |
|---|---|
| **Is there a relationship between technology use and teacher stress in the technology-rich classroom?** | |
| • Do teachers report that the use of technology causes stress? | **Survey:** questions about teachers' perception of their level of technostress, the regular use of the technology, their way of dealing with problems, and their suggestions for solutions |
| • Can evidence for this be found in classrooms? | **Classroom Investigation:**<br>• Observation of the ability of the teachers to deal with the technology, their interaction with technological environment<br>• Interview teachers about their perceptions of the nature of this interaction |
| **Does increased use of technology result in increased stress?** | **Survey:** correlation of data about the increase use of technology per day and the reported increase of stress |
| **Is there an association between the attitude towards technology and the individual's report of experiencing technostress?** | **Survey:** correlation of data about the attitude towards technology, the reported increase of stress, and the reported causes of stress by the participants |
| **Is this experience of technostress associated with age, gender, type of school, attitude, and amount of use of technology?** | **Survey:** cross tabulations of demographic data with reported causes and symptoms of technostress |
| **What are the main stressors associated with technostress?** | |
| • What do teachers report as the main causes of technostress? | **Survey:** response to question on causes |
| • What are found to be causes of technostress in the classroom? | **Classroom Investigation:**<br>• Observation<br>• Interview |
| • To what extent can we relate causes to forms of job complexity? | **Interpretation of:**<br>• Survey: response to question on causes<br>• Observation and interview about causes, under three categories: workload, unpredictability, and simultaneity |
| **What are the chief symptoms of technostress?** | |
| • What do teachers report as the consequences of stress experienced whilst using technology in the classroom (symptoms of technostress)? | **Survey:** response to question on symptoms |

| | |
|---|---|
| • What are found to be symptoms of stress in the classroom? | **Classroom Investigation:**<br>• Observation for physical and the behavioural symptoms<br>• Interview about symptoms |
| **What are the coping strategies that teachers use to deal with technostress?**<br><br>• What are the reported strategies they use to deal with this stress (coping strategies for technostress)?<br><br>• What are found to be coping strategies used in the classroom? | <br><br>**Survey:** responses to open-ended question on the coping strategies used with technostress<br><br>**Classroom Investigation:**<br>• Observation for observable coping strategies<br>• Interview for reported coping strategies used by the teacher |
| **What is the nature of the relationship between technology use and techno-stress? Is this a relationship mediated by the personal understandings of the teacher, and if so in what ways?** | Construction of case studies of teachers' experience of technostress |
| **Does the T-Te model provide an adequate model of this interaction?** | Comparison of model with case study descriptions |

**Table 7: Research questions and methods**

The following sections will describe the survey method and classroom investigation method, and then will discuss the issue of ethics.

## *5.5. The Survey*

The main survey was developed from the survey used in the preliminary study. Some subscales were added – as we will explain later – that would measure general levels of stress because an extreme state of general stress, psychological distress, or ill-health is likely to mask the impact of any specific causal factor on stress; therefore, it was decided to exclude those exhibiting high levels of general stress, psychological distress, or ill-health. The initial design of the main survey was sent out for comment to 33 experts in the area of stress and in 'research design', from the UK and the USA. Some experts responded, and their suggestions were taken into consideration before sending the survey in April 2005 to a number of schools in London. These schools were identified from a search using the Web site (http://www.schoolsnet.com/) that lists schools in the UK. There were some obstacles faced by the researcher while delivering the questionnaire: Some schools did not agree to give the survey to the teachers. Some said they were busy with another researcher at the school, whereas other schools said that both teachers as well as the administration were busy – for example with Ofsted inspections. A number of schools did not return the survey, and an effort was made several times to contact them without success.

### *5.5.1. Elements and Subscales*

This part discusses the elements and subscales (see Appendix D), and the reasons for including them in the survey. One set of elements consists of questions about demographic characteristics such as age, and gender.

Another set of elements includes questions about the attitude of teachers towards technology, their frequency of use of technology, the kind of technology they use, and their experiences in using technology. It was of concern to find out if there is association between the high level of the use of the technology and the individual's report of experiencing technostress. In addition, it was of concern to find out if there is association between the attitude towards technology and the individual's report of experiencing technostress.

The first and second subscales in the survey were about *technostress-causes* and *technostress-symptoms*. These scales allow the researcher to ascertain the frequency of the main factors of stress process (see chapter two). Some symptoms and causes derived from the literature were listed in the survey. Some points in the questions about causes and symptoms were kept as open-ended questions to allow teachers to express any feelings and experiences that might throw more light on the process of technostress in the classroom.

Four subscales were used in this survey; they are about the health status, the perceived stress, the social interaction, and psychological illness. They were used to select the participants whose data will be analysed. It is impossible to detect any impact of technology on stress for participants with high scores. These subscales will not be use for further analyses related to the research questions, and they will be considered as primary diagnoses per se, and will be highlighted below. Although there are other scales in the literature for similar purposes, these are general and not long, as this might affect the length of the questionnaire.

Perceived Stress Scale (PSS) is widely used as a psychological tool to measure perception of stress. It consists of 14 items and was designed to "measures the degree individual cognitively appraise their lives as unpredictable, uncontrollable, and overloading. Respondents rate how often they experienced a particular feeling or thought during the past month on a 5-point scale ... The items are summed for a total perceived stress score; the higher the score, the higher the perceived stress" (Abel, 2002, pp. 369-70). Questions 1-3, 8, 11-12 and 14, are range from never (0) to very often (4); and questions 4-7, 9-10, and 13 are range from never (4) to very often (0).

The GHQ (Goldberg, 1972/1978) has been used to "indicate the likelihood that the individual is suffering level of tension, anxiety, and depression high enough to adversely affect physical and mental wellbeing" (Punch and Tuettemann, 1990, p. 370). This measure may allow the researcher to go some way in controlling for other health factors that might be involved in causing stress to an individual when looking for the effect of one stressor. Researchers use different forms of GHQ such as: 12, 20, 30, and 60 item scales (see Punch and Tuettemann, 1990); in this study, the 12 item scale was used. The GHQ scale asks respondents to indicate the extent to which they have experienced a list of somatic and affective symptoms over the previous 6 weeks, relative to their usual level of health on a 4 point scale (scored 0-1-2-3) (Moyle and Parkes, 1999, p. 631). The items are summed for total teachers' 'past few weeks health experience'; the higher the score, the worse the health conditions reported by teacher. The scale was justified as the following: score > 15 indicates evidence of distress, and score > 20 indicates likely severe problems and psychological distress (see, Goldberg and Williams 1988; and WHO, 2004).

In the social interaction subscale (SS), the teacher would rate the support he/she receives from their families, friends, and community (adapted from Henderson, 2006). Responses could range from 'not at all' (4) to 'much more than usual' (1) The items are summed for a total 'social interaction' of the teacher; the higher the score, the worst social interaction and vice versa.

The ‘psychological distress scale’ (PDS) consists of six questions that measure ‘serious mental illness’ (SMI) or identify persons with serious psychological distress (see Kessler, et al., 2003; Pratt, et al., 2007; and National Center for Health Statistics, [NCHS], 2007). Many studies have reported a negative relationship between major life events and psychological distress (Thoits, 1982). Teachers rate their feelings or opinions on a 5-point scale ranging from ‘none of the time’ (0) to ‘all of the time’ (4). The items are summed for total teachers’ ‘psychological distress’; (the scale was justified as the following: A score of 13 or more is considered as indicating that the persons likely to have serious psychological distress (see, Kessler, et al., 2003; Pratt, et al., 2007; and National Center for Health Statistics [NCHS], 2007).

Additionally, two questions were about accidents, injuries and other significant life events experienced by the teacher during the past year. It is possible that certain life events such as accidents, divorce, or death of spouse or close friend might cause long-term stress for some individuals; thus, his/her response to any other situation might be negatively affected (see section 2.3). These two questions were wrongly added, because it was already possible to discover the effect of such life events on the responses via the health and the psychological scales used (GHQ, PSS, and PDS).

The survey contained some open-ended questions in which participants were asked to write about their own experience regarding: (a) the symptoms they had experienced that were different from those mentioned in the survey’s symptoms list, (b) the main causes of stress associated with their use of technology in teaching, and (c) the methods they use to cope with such causes of stress, and the solutions that might help to reduce technostress in classroom. Another question was about the types of technology used that were different from those listed in the survey. These questions were intended to cast further light on the strategies and responses of teachers. NVivo was used to support the analysis of the open-ended questions.

In summary, the survey consists of the elements and subscales that illustrated in Table 8, below:

| Elements | Reason | No of questions |
|---|---|---|
| Demographics | Information about participant's age, gender, etc. | 5 |
| Attitude towards technology and experience of technostress | Information about participants use and familiarity with technology | 8 |
| Difficult situations | Injury and life events experienced by teacher | 2 |
| **Subscales** | | |
| Technostress – causes | Factors associated with technostress | 15 |
| Technostress – symptoms | Symptoms associated with technostress | 16 |
| Perceived Stress Scale | Measure of teacher's general perception of stress | 14 |
| General Health Questionnaire | Tests the general health status of the individual for a period of time | 12 |
| Social interaction | Social support and teachers' relationship with families, friends, and community | 5 |
| Psychological distress | To investigate the participants' serious mental illness for short period of time | 6 |

**Table 8: Elements and subscales of the survey**

### *5.5.2. Validity and Reliability*

#### Validity

Validity "refers to the extent to which a measure assesses what it is claimed to measure" (Howitt and Cramer, 2005, p. 219). There are a number of forms of validity: content, concurrent, construct, predictive, differential, and face validity (DeVaus, 2002; Al-Mohannadi, 2004; Howitt and Cramer, 2005).

It can be difficult to choose the appropriate type of validity for a measure in a specific study. DeVaus (2002) states "there is no ideal way of determining the validity of the measure the method chosen will depend on the situation" (p. 54). The only form of validity assessments the researcher was able to make was that of face validity. To determine face validity, "one inspects the test items in order to assess whether on the face of things (that is, in terms of the content of the items) the test would appear to be a measure of the ... concept concerned" (Howitt and Cramer, 2005, p. 224). As stated previously, the survey was sent to a number of experts and researchers in the field of stress for feedback. Their comments about the survey were helpful and encouraging, and their suggestions were taken into consideration in redesigning the final form of the survey. It was not possible to examine concurrent validity since no other test was found of technostress in the classroom.

GHQ (12 items), PSS (14 items), and psychological distress (6 items) scales have been used by previous researchers who have provided arguments about their validity (for GHQ, see Picardi, et al., 2001; for PSS, see Cohen, et al., 1983, and for psychological distress, see Kessler, et al., 2003; Pratt, et al., 2007; NCHS, 2007)

### Reliability

If an individual gives the same responses to the same questions at different times then the survey is said to be reliable. Because it is often difficult for researchers to ask the participants to answer the survey on two different occasions, alternative approaches have been used to evaluate the reliability of the survey (DeVaus, 2002). One approach is to look at reliability in terms of the consistency of scales, and this can be measured by 'Cronbach's alpha coefficient'. It is a suitable instrument for measuring the reliability of some of the sub-sections of the survey. DeVaus (2002) explains that calculating the item-total correlation coefficient will tell if the response to a particular item reflect the responses of the remaining items in the scale. The range of the correlation coefficients is between 0 and 1, and if the item-total correlation is < 0.3, then it should be generally dropped from the scale, whereas the higher the item-total correlation the more clearly that the item belongs to the scale (see DeVaus, 2002).

The survey consists of six subscales, for the technostress-symptoms and technostress-causes subscales, the researcher is aware of the difficulty of measuring their reliability as they were different from other scales and there is no obvious meaning that can be attached to summing the items of the scale. The technostress-symptoms scale consists of some groups of symptoms, which might be related to each other; for example, the items for the psychological symptoms may well relate to one another and therefore the researcher also applied Cronbach's alpha as a measure of reliability of the technostress-symptoms scale. The same test to the technostress-causes scale was applied to check to what extent the various causes of technostress could be seen as related to an overall score arising from identifying and ranking the causes of technostress. This will be illustrated below.

### Technostress-symptoms

The number of responses was 119 teachers and the Cronbach's alpha was (0.737) for n=16 items. The alpha coefficient indicates that the 'technostress – symptoms' scale has acceptable reliability. Importantly, the item-total coefficient is less than 0.30 for items 1, 4, 8, 12, and 16; these items will be dropped temporarily from the scale. After dropping those items, the alpha coefficient was recalculated for the remaining items. Calculations after questions 1, 4, 8, 12, 16 have been dropped from the scale showed that the item-total coefficient of question 2 was 0.284, and was, therefore, unreliable and so should also be temporarily dropped from the scale. Therefore, the items dropped from the scale were: 1, 2, 4, 8, 12, and 16. The Cronbach's alpha coefficient was 0.835 for the remaining ten items, indicating that this subscale had good reliability. All of the ten item-total correlations are more than 0.30, so all the items will be kept in the scale. Some of the items dropped from the scales involved negative questions such as 'Have you experienced no physical symptoms?' and these had correlations that were very different from the rest of the correlations, so it was thought that these questions (4, 8. 12, and 16) were found difficult to interpret or answer adequately by the respondents, so it was decided that these should be dropped. The other two items have somewhat lower correlations than the remaining items, but they are not dramatically different: They are muscle tension (0,237) and rapid heartbeat (0.346) and are physical symptoms, whereas almost all other questions were about behavioural and psychological symptoms, so it is perhaps not surprisingly that the correlation was lower. These two factors, therefore, were retained.

### Technostress-causes

The alpha coefficient of the 15 items is 0.907, indicating that the 'technostress-causes' subscale has high reliability. The item-total correlation indicates that the correlation for all of the items is more than 0.30.

### Reliability of the Subscales (PSS, GHQ, SS, and PDS)

The following Table 9 shows the reliability of the other four subscales (PSS, GHQ, SS, and PDS).

| Subscales | No of Items | Reliable items | Cronbach's alpha coefficient | Reliability |
|---|---|---|---|---|
| Perceived Stress Scale | 14 | 14* | 0.852 | good reliability |
| General Health Questionnaire | 12 | 12 | 0.936 | high reliability |
| Social Interaction | 5 | 5 | 0.752 | acceptable reliability |
| Psychological distress scale | 6 | 6 | 0.854 | good reliability |

**Table 9: Reliability of the subscales**

Note. *One item (no 12) was <0.3 with 0.857 Cronbach's alpha coefficient if item deleted, so as this scale has been extensively tried and its reliability established with much larger samples than the sample in this study and using both internal consistency and test-retest correlations the reliability of the scale is established (see Rush, et al., 2000), so it was decided to keep the item, and accept the overall reliability of the PSS.

The survey consists of 83 variables. Reliability tests were applied to test the various subscales. Four items were found to be unreliable and therefore were dropped from the survey. These four items were dropped from the 'symptoms of technostress' scale. The remaining 79 items consist of 15 items about gender, age, school, teacher attitudes, and so on, 14 from the PSS, 5 about social interaction, 12 from the GHQ, 6 about psychological distress, 12 about symptoms and 15 about causes.

The correlation matrix was also used to investigate the relationship between the subscales for 119 teachers (see Table 10). This shows a positive and substantial to very strong relationship between PSS and GHQ; positive and very strong relationship between psychological distress and PSS; and positive and very strong relationship between psychological distress and GHQ. It is to be expected that such a relationship would be found between the PSS and the health scales GHQ and psychological distress – as one might influences the other, for instance, poor health status might affect the PSS - , and thus confirm to some degree the reliability of such scales. This positive and strong relationship indicates that those who reported high scores in one scale tended to get high scores in the other scale. The correlation matrix in Table 11 used to investigate the relationship between the subscales for 97 teachers. There were slight changes from the previous table (Table 10), and the strength of the relationships have changed slightly. The reductions in the correlation coefficients for relationships between GHQ, PSS, and Psychological Distress are probably due to taking out the extreme points of the distributions.

## Correlation Matrix

| | | Physical symptoms | Psychological symptoms | Behavioral symptoms | causes | PSS | GHQ | social interaction | Psychological distress |
|---|---|---|---|---|---|---|---|---|---|
| Correlation | Physical symptoms | 1.000 | | | | | | | |
| | Psychological symptoms | .341 | 1.000 | | | | | | |
| | Behavioral symptoms | .191 | .480 | 1.000 | | | | | |
| | Causes | .095 | .278 | .133 | 1.000 | | | | |
| | PSS | -.193 | -.251 | -.113 | -.085 | 1.000 | | | |
| | GHQ | -.115 | -.148 | -.106 | -.144 | .696 | 1.000 | | |
| | Social interaction | .045 | .183 | .221 | .106 | -.059 | .016 | 1.000 | |
| | Psychological distress | -.087 | -.110 | -.124 | -.069 | .754 | .739 | .020 | 1.000 |

**Table 10: Correlation matrix of the subscales (119 teachers)**

| | | Physical symptoms | Psychological symptoms | Behavioral symptoms | causes | PSS | GHQ | social interaction | Psychological distress |
|---|---|---|---|---|---|---|---|---|---|
| Correlation | Physical symptoms | 1.000 | | | | | | | |
| | Psychological symptoms | .300 | 1.000 | | | | | | |
| | Behavioral symptoms | .174 | .476 | 1.000 | | | | | |
| | Causes | .078 | .263 | .158 | 1.000 | | | | |
| | PSS | -.211 | -.264 | -.047 | -.112 | 1.000 | | | |
| | GHQ | -.103 | -.132 | -.055 | -.200 | .650 | 1.000 | | |
| | Social interaction | -.016 | .169 | .210 | .070 | -.020 | .046 | 1.000 | |
| | Psychological distress | -.096 | -.108 | -.053 | -.145 | .705 | .583 | .065 | 1.000 |

**Table 11: Correlation matrix of the subscales (97 teachers)**

**Note. Strength of relationship coefficients:** 0.01-0.09 trivial relationship; 0.10-0.29 low to moderate relationship, 0.30-0.49 moderate to substantial relationship; 0.50-0.69 substantial to very strong relationship; 0.70-0.89 very strong relationship; 0.90+ near perfect (see DeVaus, 2002, p.259)

Although the researcher has tried to make the test as valid and reliable as possible, it was accepted that this is not completely possible for the following reasons: some questions about teachers' feelings, life, social, health status, and experiences might be seen by some teachers as to reflect their weaknesses, so honest answers may not always be given, which might affect the validity as well as the reliability of some subscales in the survey.

### *5.5.3. Sample*

The questionnaires were distributed to 14 institutions in London: five secondary schools; five primary schools; and four CLCs. The questionnaires were handed to an administrator in each of institutions – 20-30 for the secondary and primary schools, and 5-10 questionnaires for the CLCs. 136 questionnaires were returned, and 119 were regarded as complete; the others were ignored because they were not fully answered. In addition, it was decided to drop three groups of respondents from the sample because it might be difficult to detect any impact of technology on stress for people with high levels of stress; these groups were those with high scores in:

- Health status as measured by the GHQ.
- Complaining about social situation.
- Mental illness as measured by the psychological distress scale.

There were no high scores in the perception of stress scale (PSS); therefore, no case was dropped. This resulted in 22 participants being excluded from the main sample – though the results for these 22 will be examined separately to see if they reveal any particular patterns. The scores of the three groups will be shown in the following Table 12.

| SS Teachers with High Complaining Scores about Social Interaction Excluded | GHQ Teachers with High Scores In Health Problems Excluded | PDS Teachers with High Scores In Psychological Distress Excluded |
|---|---|---|
| 9 | | |
| 11 | | |
| | | |
| 18 | | |
| | | |
| | 28 | |
| | 36 | 36 |
| | 37 | |
| | 38 | 38 |
| | 41 | 41 |
| 51 | | |
| | | |
| | | 53 |
| | 54 | 54 |
| | 60 | |
| 63 | | |
| | | 79 |
| | | 84 |
| | | 86 |
| | 89 | 89 |
| | 100 | |
| | 110 | 110 |
| 111 | | |
| | 113 | 113 |
| | 116 | 116 |

**Table 12: Excluded Cases**

6 Teachers were excluded because they reported very poor social interaction. Strangely, none of these teachers occurs on the lists of those with severe health problems or severe psychological problems; the researcher does not know about the reason and cannot be certain about them. The other two groups of those with severe health problems and severe psychological problems seem to have a degree of overlap (8 out of 16 are on both lists). It was decided to exclude these cases, so the exact number of the participants will be 119 minus 22 for a total of 97. Some main elements of the analysis will be redone with these 22 cases included to see whether this impacts on the results of the analysis.

## *5.6. The Classroom Investigation*

After designing the survey, the plan was to go to the field, 'the technological classroom', and see how the technostress found in the survey looked in practice. Three methods (observation, GSR, and interview) were used to describe the phenomenon of technostress in the classroom. These three methods along with the validity and reliability issues, and the sample of the classroom investigation will be described below.

### 5.6.1. Observation

Classroom observation is a difficult method in educational research, and the difficulty lies in the complexity of the classroom environment (see section 4.3) and in deciding what should be the researcher's focus of attention (Wragg, 1994). In this study some of the limitations of observation (see Sarantakos, 2005) and classroom observation (see Wragg, 1994) might be less than other studies, as this study is dealing with events that are mainly related only to the use of the technology by teachers. As little has been written on this topic it was important to go into the field and look at the actual situation in the classroom.

The approach of observing teachers in the technology-rich classroom was used:

- To record any events related to the use of the technology by the teacher, and in the classroom context.
- To record the teacher's behaviours as responses to events related to the use of technology by either themselves or the students.
- To register any signs of psychological changes such as sadness, anger, or frustration and/or any physical changes such as blushing or sweating
- To record any identified periods of change in the GSR readings that might be associated with changes in stress level, for possible use in the interview.

While undertaking an observation, the researcher observed the teachers in the classroom using the technology as an aid, and the activities of the students were not recorded. Teachers were informed about the visit and the aim of the observation before the researcher arrived at the classroom. Teachers who participated in this study were asked to ignore the researcher, the video camera, and the instruments in the classroom. The classroom conditions were not otherwise changed during the experiment. In addition, teachers and students were asked to work as they usually would so that normal classroom activity would be present. The plan was to arrive in the classroom 30 minutes before the lesson started. The researcher placed the video camera and the researcher's computer (with the GSR reader) somewhere in the classroom where the teachers' actions could be captured, then observe the teacher after starting the GSR reading and the video recording. While undertaking observations, the researcher wrote notes and tried to concentrate on the main events related to use of technology, time of events, teachers' behavioural responses, involvement of students, and the changes in the GSR readings.

Video recording of the teachers' activities was carried out for two reasons: firstly, so that they could be reviewed several times in order to look for events that the researcher did not notice at the time, and secondly, in order to replay to them during interviews when teachers asked to see them. When the researcher looked at the tapes, notes were taken about teachers' behaviours while using technology that might have been missed noted during the observation, and time of changes in the GSR was compared with times codes on video logs. On some occasions, teachers disagreed that they experienced stress at the time of changes in the GSR when they were interviewed, so the researcher investigated what was his/her behaviour at that time as recorded on the video logs, and added notes to the interview data describing that behaviour. Teachers were asked after the interview if they wanted to retain the tapes but all felt at ease with the researcher keeping them.

One session will be discussed below for the purpose of giving the reader an idea about how the observation was conducted in the study. The first part of the session will describe the classroom that was observed, and the second part will illustrate some raw data that was gained through notes from the observation.

### The Session

This session is an example of the other sessions that were observed and then used for analysis. After conducting the observation, making some notes, conducting the interview with the teacher and making some notes on the transcript (such notes as some background information about each teacher), and also playing back the recorded videotapes, the researcher started to write down about each session, focusing mainly on what has happened in the classroom. The following session was chosen from 15 sessions observed and will be described in general overview. Some details will not be included, as they may make the description too long, and thus lead to lose the purpose of describing the observation. Following the description of the observed session, there will be some notes about the session; some points in the notes section might not be included in the description of the session below.

In this session, Teacher S was observed. The session was 'ICT Co-ordinators' Training'. The session ran from 9:30 am to 12:00 noon, and the participants were ICT co-ordinators from schools in London.

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Teacher 'S' was in the class at 9:10 am, preparing for students who were due to arrive at 9:30. We started a short discussion during which she told me that she does this preparation every time there is a class so that everything will be ready before the students arrive. She checked the board, the projector, and all the computers in the room, entering the password into each. She then checked whether the software on the screen was working properly. I asked about her feelings, to which she replied that doing this preparation makes her feel stressed.

The classroom was equipped with an interactive white board (IWB), electronic overhead projector, and four long rows of tables and chairs. The tables in each row were linked to each other and placed longitudinally from the front to the back of the classroom. The two rows on the sides of the classroom were facing the walls, whereas two rows were facing each other in the middle of the classroom. Each table was equipped with a PC and headphone. There was a printer in the classroom and a small table for the teacher beside the IWB. The teacher's table was equipped with a PC and telephone. There was a chair beside the table. The lighting and the heating systems in the classroom were in good working order. All the cables were linked beneath the tables and were not obstructing the teacher or her students. The teacher as well as the students could access the network in the school.

9:13 I attached the GSR to the teacher's wrist and her middle fingers. She said that it was fine and it did not obstruct the movement of her hands. I put the video camera at the back of the classroom. My laptop computer was in a place where the signal of the GSR could be received easily. A few seconds later, the GSR counter showed changes in the reading of the skin response. It seemed that she was a little nervous because of the teachers she was about to teach. She had said in an earlier discussion that they (ICT teachers) were very important for her, and this subject (guidance on ICT curriculum and assessment for ICT coordinators) had caused problems before – although what was meant by this was not explained. Students came to the classroom at different times before 9:30.

9:33 The session started. The teacher introduced me to her group and asked them to ignore me. There were four male and fourteen female students in the classroom. She briefly explained what she was going to teach in this session – which was first explaining a new voting software, assessment and ICT, ICT and capability, and finally explaining some educational software. She started teaching a few minutes later and asked the students to use the vote instruments connected to their computers. However, they did not work! The students reported the problem to her, so she asked them to try again. They still did not work. That was around 9:35 and the GSR started to increase from -18.00m and reached -6:00m. The teacher tried to resolve the problem but was unable to. She tried to explain the problem but was unable to explain why they were not working or solve the problem. A short time later, unable to make the vote instruments work, she started to talk about another subject.

9:44 The teacher was explaining about assessment, and observations showed that some students were talking to each other, others were using their computers, which suggested that perhaps they were a little bored. She asked the students if they wanted to ask any questions or to give their opinions about the session so far.

As the students did not ask any question at all about the session, she asked about the ICT capability and then started talking about ICT capability, writing some points and definitions on the board about ICT capability. There was a long debate about the issue of capability, and some students made positive interjections based upon their experiences, whereas others stated that those who designed software did not consider the capabilities of pupils or their limitations in understanding some functions of the software, stating that some ICT might be easy for teachers but not for pupils. This discussion about ICT capability took some time, after which the teacher stated that there are some simple and useful educational Web sites that teachers might use in their classroom, some of these Web sites were used by the CLC and had been introduced to some teachers who had visited the CLC before. After explaining about such Web sites, she asked the students to navigate through some useful educational links on the CLC Web sites and print out information about useful links that they might need in their schools.

10:08 One of the students could not get access to the printer and asked for help. The teacher tried solving the problem but could not, so she attempted to ring a technician but could not get a reply. She then tried to solve the problem again from her computer but without any success. Her face became flushed. At the end, she went out of the classroom to get help from others.

A few moments later she came and told the student that the printing system in the centre had changed, which was why they could not print. Then she continued teaching and show students some useful educational links; these were provided by the CLC, and some were free for teachers to download from the CLC Web site. Some students were navigating the Internet, one student was writing an e-mail, and thus were able to virtually ignore the teacher. They were keeping themselves busy with the computers: Some were navigating the Internet but not the links she suggested, as the researcher can see on the PC screens closest to him. In these instances, teacher S was moving around and asking students if they needed assistance, but no one asked for assistance. Other students talked to her about a range of issues. The teacher sat near two students in the middle of the classroom and started talking about the lack of technology in their schools: Some claimed that they had one PC classroom that was used by many teachers and needed to be reserved in advance, and they were embarrassed by what they had seen in the CLC. While the teacher was talking to the students, she was smiling and laughing. At this point, the GSR reading reduced. During this exchange with the students, there was no direct use of technology. The teacher spent the remaining time of the session (about half of the entire session) talking to the students moving from one place to another, sometimes talking with a student or group of students for ten minutes or more. The others were either navigating the Internet or checking the links the teachers suggested – which was the final part of the session - whereas some others were chatting with each other.

10:46 am. End of session.

**Notes on the Session**

When observing a session, some notes were taken, whereas others were taken after replaying the videotape recorded while observing. The notes taken gave examples of some indications of the environmental variables (TE) and the teacher's variables (T) from the point view of the researcher (and so may be thought of as 'objective' in the sense that they were not part of the perception of the teacher). For the purpose of giving the reader an idea about how the notes were taken, the following notes were recorded during the previous observation: They concentrated on the negative aspects and did not record many of the positive aspects that were taken for granted at the time.

<u>Technology Environment (TE)</u>

<u>Demands</u>

- Preparing the equipment
- Fixing errors of the vote instruments and the printer
- Monitoring students' use of the software
- Explaining the use of the software
- Controlling students in technological classroom
- Teaching theoretical aspects by technology

<u>Supply</u>

- No reply from technician
- No help from others in the school

<u>Teacher (T)</u>

<u>Ability and Control</u>

- The teacher was in the classroom before the session started, preparing the equipment for the students
- Trying to fix the errors but no success
- 15 to 20 minutes to explain the software by the teacher.
- Some students ignored the teacher, and played with the technology
- Teaching theoretical aspects of the sessions by technology failed and so was replaced by the use of the whiteboard.

<u>Need</u>

- Support from the technician
- Support from the school staff

Symptoms

- Teacher's face became flushed when she could not solve the problem of the printer
- Change in the GSR readings (see section 7.2.1 below)

Coping

Different ways of coping were used by teacher S to deal with the problems. For example, trying to fix the errors and seeking support from the technician.

### *5.6.2. Galvanic Skin Resistance (GSR)*

It is argued by some researchers that emotions can be detected from the biosignal changes of an individual, using a range of physiological sensing means (Prendinger, et al., 2005). Two types of physiological sensing are commonly used, namely blood volume pulse (BVP) and galvanic skin resistance (GSR). GSR signal is an indicator of skin conductance (Seyle, 1956; Wilson, and Sasse, 2000a; Prendinger, et al., 2005). The use of GSR is based on the fact that the type of sweat gland (the eccrine) found in the palms and fingers of the hands "respond only weakly at certain levels of heat and strongly to psychological and sensory stimuli" (Andreassi, 2000, pp. 192-195), therefore, the hand is an appropriate place for applying the GSR instruments. Other researchers argue that it is not clear whether the physiological changes detected by the GSR are consequences of stress or not. Some researchers attribute the changes either to the reason that the skin is toughened to be protected against injury, or to the reason that the skin need to be cooled in fight/flight situation (Wilson and Sasse, 2000a). Others argue that sometimes "skin conductance level indicates more sustained autonomic activation which indicates an effortful allocation of attention resources, which is associated with enhanced sympathetic autonomic activation" (Trimmel, et al., 2003).

Some studies used GSR, for example Prendinger, et al. (2005) used the GSR and BVP in addition to a questionnaire to measure user frustration and stress in their study, which aimed to "investigate the effect of a lifelike character with expressivity on the affective state of users" (p. 231). They conclude that their study supports "the explanation of relating SC (skin conductance) with stress and frustration" (p. 242); that is, the increase in the SC readings was due to the increase of the level of the stress of the user. Their conclusion is contrary to the conclusion of Pecchinenda and Smith (1996) who "demonstrate that SC increases with higher levels of engagement in the task of solving a difficult problem-solving task" (p. 242), but not due to the increase of level of stress of the user. Prendinger et al. (2005) claimed that

> In the light of their [Pecchinenda and Smith (1996)] study, the high level of SC during delay period could be interpreted in terms of a high level of users' engagement rather than stress. However, since SC significantly decreased only when the character expressed empathy afterwards (and not when the character ignored the delay), the explanation of relating SC with stress and frustration seems strongly supported in our experiment (p. 242)

Many other studies support the claim of Prendinger, et al., (2005) about the positive correlation of skin conductance with arousal and stress (see, for example, Levenson, 1988; Picard, 1997). Another study was conducted by Ward and Marsden (2003) which aimed to investigate the physiological changes of the user to different Web page designs. In their studies, SC, blood volume, and pulse rate were monitored. They conclude that the methodology they used provided a good measure of the usability of software (Ward and Marsden, 2003, p. 211). Ward and Marsden (2003), also argue that the baseline might vary from time to time (see also SC inconsistencies' factors, Idzikowski and Baddeley, (1983). Scheirer et al. (2002) used SC and BVP to see whether regimes which might lead to frustration could be automatically distinguished from those that did not, and find that the pattern recognition approach that they used was correct 67.4% of the time" (Scheirer, et al., 2002, p. 93). Scheirer, et al., (2002) argue that there was a delay in registering the GSR data of some seconds. Lisetti et al. (2002) used wireless Autonomic Nervous System (ANS) sensing of heartbeat and GSR to measure the emotion of a participant while he/she watched a horror movie. They conclude that "our initial experiment shows that we can perform real-life experiments to measure affect and emotion which is bound to render effective computing research very useful" (Lisetti, et al., 2002). However, the study showed changes in the GSR reading during the scary parts of movie, which would imply that the GSR readings corresponded with stress. Moreover, Trimmel, et al., (2003) used the GSR to investigate the stress response caused by system response time (SRT) when searching for information on the Internet by students (n=26). The findings show that the signal of the GSR increased from the baseline. In addition, changes were different according to the duration of the waiting period of the response of the system.

Some other limitations of the GSR were reported by some studies; for example, some studies found a time-lag in GSR reading following a stress event, which might affect the result (see, Scheirer, et al., 2002). Changing in the baseline readings in the GSR from time to time and from place to place were also reported by some studies (see, for example, SC inconsistencies' factors, Idzikowski and Baddeley, 1983; Ward and Marsden 2003).

Although the limitations of the GSR raised by the above researchers put some doubts about using it in this study, the findings of other studies raise the possibility of doing this in classrooms with teachers. Moreover, because it is available as a wireless instrument and will not affect teaching, it was decided to use it. However, the use of the GSR in this study was not a primary method to indicate stress but rather a supportive method for the observation; that is, if observation seemed to indicate stress and the GSR reading also indicated the likelihood of stress, then that will be seen as providing additional evidence that the person is stressed.

Operationally, the GSR consists of two electrodes (small metal plates) attached to the individual's skin. Its function is to apply a safe and small voltage to the skin to measure the skin's conductance. If the activity in the sweat glands increases (due to psychological changes), there will be a fast increase in the skin's conductance and if the glands are saturated with sweat, that will abstract the increase of skin's conductance (see Picard, 2007) i.e. in case of threat, the skin will sweat, and the amount of sweat changes the reading of the GSR and determines the level of stress. A high amount of sweat leads to low resistance and high conductivity which mean more stress, whereas low amount of sweat leads to high resistance and low conductivity, which mean less stress.

A wireless GSR was used, so it would not impede the teacher's activities in the classroom. The device is connected to the teacher's hand and the GSR readings are transmitted and received by a Bluetooth interface connected to a notebook computer. Generally it takes from 1.0 to 3.0 seconds for the appearance of the skin conductance response after the presentation of the stimuli (see, Andreassi, 2000). Skin conductance unit is mohs (m) (Andreassi, 2000, p. 196). Changes of responses will be shown on digital display of the GSR on the computer.

The GSR was used to identify periods of change and attempted to identify events in the classroom that might be associated with changes in stress level, i.e. the researcher checks regularly the GSR readings in different times while observing the teacher.

While the researcher was in the classroom, (a) he checked the reading of the GSR regularly and wrote some notes (including time, event, and the exact reading on the GSR i.e. the highest reading), making notes of the GSR reading will save time during the interview[3]; (b) later, the researcher went through the videotape and made note of all seemingly stressful incidents, then took these and marked them onto the GSR readings, looking to see if the GSR reading occurred. This was manual work that took a lot of time and effort, and it was considered as a difficulty experienced when the researcher used this method.

### 5.6.3. *Interview*

After observing the session, the teacher was interviewed. In the interview, the focus was mainly on the events related to the use of the technology. The researcher sat in front of the teacher in the same classroom in which the lesson was conducted. A tape recorder was used to record the interview. Sometimes the teacher was asked about the changes in the GSR and his/her behaviour as observed during their lessons. It was expected that all teachers during the interview would ask for evidence, so questions about events were supported by videotaped segments of their teaching, and GSR reading when the researcher thought it might be useful. Segments were shown to the teachers only if during discussing an event with the teachers they asked to be shown the tape to clarify what happened – actually, only two teachers asked to see two episodes on the tapes. Questions such as the following were asked: (a) What was your feeling about an observed event? (b) What was the reason? (c) How did you manage to cope with it? Only a selection of the observed events – which the researcher thought that they were worth asking the teachers, mainly events that were

[3] The starting time in the GSR is different from the starting time of the session, as we have to connect the GSR to the teachers some time before the session starts in order to record the baseline on the GSR for each teacher.

noticed that they caused high changes in the GSR or those events that teachers took long time to solve - were covered in the interview because of time constraints. Some of the questions in the interviews were general questions about the teacher's experiences about teaching with technology in the observed session.

Patton (1990) comments that "the purpose of interviewing is to find out what is in and on someone else's mind ... We interview people to find out from them those things we cannot directly observe" (Patton, 1990, p. 278). To determine whether something causes stress, it is important to ask the individual about his/her feelings and experiences. The researcher believes that, as Patton mentioned above, interviewing could be an appropriate method to find out from the participants about their stress and could supplement evidence from the observations. Asking individuals will give a clearer idea about what was happening to him/her in a potentially stressful situation (see Lazarus and Folkman, 1984). The researcher can also gain valuable incidental information that might otherwise have been overlooked regarding aspects of the topic, such as if stress has increased or decreased and the perceived reason for it. Information might be also driven about participant's own perceptions of their experiences.

This study used a semi-structured interview where the interviewer prepared some points and allowed the interviewee to add and mention whatever he/she wanted to say. In a structured interview, the interviewer follows set questions in strict order. This method was not used because although the results obtained are well organised, some points might not be covered because of the limitations imposed upon the exchange by the nature of the questions. In an unstructured interview, the interviewee is allowed to discuss their situation or the topic without some of the restrictions of other approaches. This approach may yield a lot of background information, but that information may or may not be related to the central focus of the study (Greenfield, 2002, p. 212).

The interview will succeed if the interviewer and interviewee establish an open and honest interchange based upon mutual respect and understanding. For this to be the case, the interviewer has to learn how to make the interview interesting, friendly, simple, and clear. Tasks such as preparation of the interview are important as well as having awareness and sensitivity to issues around interaction, body language, and confidentiality. Other factors that make the interview a success are: an avoidance of conflict and challenge, maintaining a focus upon the topic, and balancing the needs of time with the need of the interviewees to express themselves. Finally, the data should be analysed as soon as possible after the interview (Greenfield, 2002).

### *5.6.4. Reliability and Validity*

Reliability can be defined in qualitative data as "a kind of quality test of the method used ... the methods should not be influenced by chance, but ideally they should give the same result every time they are used" (Aborg, 2002, p. 31). Although some researchers (for example, Creswell, 2003) claim that reliability issues play a minor role in naturalistic qualitative research compared to quantitative methods on subjective data such as that elicited from responses to questionnaires, this study will consider reliability. For the classroom, data triangulation will be used to try to establish reliability and validity.

Validity "refers to the ability to measure what you intend to measure" (Aborg, 2002, p. 32). Researchers describe a range of strategies that can be used to check the accuracy of findings; for example, Creswell (2003) lists eight strategies to validate the accuracy of the findings and recommended that researcher use one or more (if possible)[4]. Among these strategies is 'triangulation' whereby researchers "triangulate different data sources of information evidence from the sources. Then use it to build a coherent justification for themes" (p. 196). Golafshani (2003) argues that triangulation is "typically a strategy for improving the validity and reliability of research or evaluation of findings" (Golafshani, 2003, p. 603). The current study uses different tools as sources of data namely: observation, interview, and GSR, and will attempt to triangulate the data from these sources.

### *5.6.5. Sample*

Letters were sent to a number of schools in London and the participants were responding teachers who taught in the schools. Teachers were selected for the study

[4] Other strategies were, for example, 'spend prolonged time in the field'; or taking the final report back to participants (member-checking). For more strategies, see Cresweel, 2003, pp. 196-197.

based on the criteria that they used technology in the classroom, therefore before selecting teachers, the researcher visited their schools. Some were met in their classrooms or in the teachers' room in the school and were asked about the technology they use for teaching. A much smaller number of teachers were included in the qualitative study than in the survey. This was decided because there was a need to study in-depth teachers' feelings and experiences in technology-rich classrooms to describe technostress, and because the study would use three methods that would demand time and effort for analysis and comparison, in addition to conducting the study in real-world classroom. Nine teachers took part in the classroom investigation, two of them working in a Community Learning Centre (CLC), two in primary and five in secondary schools in London. Table 13 shows the number of teachers, the type of technology they used, and the subjects taught.

| No | Teacher | Type of Technology | Subject |
|---|---|---|---|
| 1 | S (f)* | PC for teacher and students; IWB, software, headphones, network, Internet. | ICT |
| 2 | K(f) | PC for teacher and students; IWB, software, headphones, network, Internet | ICT, music |
| 3 | R (f) | PC for teacher and students; IWB, software, headphones, network, Internet | Math |
| 4 | P (f) | PC for teacher and students; IWB, software, network, Internet | Science |
| 5 | ST (m)** | PC for teacher and students; IWB, software. | Science |
| 6 | H (f) | PC for teacher; IWB. | Science |
| 7 | E (f) | PC for teacher and students; IWB, software, headphones, network, Internet | Science |
| 8 | D (m) | PC for teacher and students; IWB, software, network. | Business |
| 9 | Rs (m) | PC for teacher and students; IWB, software, headphones, network, Internet | Business |

**Table 13: Teachers who participated in the classroom investigation**

* Female
** Male

## 5.7. Ethical Issues

The study was carried out in accordance with the guidelines of the British Educational Research Association (BERA) (2004), and the British Psychological Society: Code of Ethics (2002). The participants were teachers in schools in the UK.

They were informed about the aim of the study, the institution of the researcher, some information about the researcher, as well as the procedures and the methods to be used were explained in detail to the participants. They were told that the results might help teachers become aware of the technostress in the future. They were told that some advice about coping with technostress will be sent to them (if requested). They were provided with the researcher's address details in case they wanted a report about their involvement in the research or any other requirements. It was suggested that other teachers, educators, and ICT producers might also benefit from the results of this study. The GSR was shown to the teachers; the way it works and information about the manufacturer were presented in the meetings before the main study was conducted. According to the manufacturer, using this instrument did not cause any problems in public, and this was explained to the teachers and clarified that the students in the classrooms would not be affected. One of the teachers in CLC wanted to participate in the study, but after explaining the procedures to her, she told the researcher that she was pregnant. Although, the researcher was told by the GSR manufacturer that they have not noticed any effect of GSR instrument on pregnant women, it was decided not to allow her to participate in the study.

The procedure of using the other methods (the observation, the interview) were explained in the meetings and before the classes started. Teachers were informed that they had the right to withdraw at any time from the study. All teachers were asked for permission to take the videotape away. They were told that the video recording would not be used to video students in the classrooms, and the tutors retained the right to hold onto the tape if they wished.

Letters were sent to the schools and the centres involved, the researcher visited the schools and explained the aim and the procedures of the research to the head teachers and asked for permission to conduct the study in their schools. E-mails agreeing to take part in the study were received from teachers and head-teachers, and some teachers asked for a report of the study results after it was completed. For the sake of confidentiality, none of the schools and teachers will be identified by name; but instead each teacher will be represented by a code - teacher A, teacher B etc. in addition, no information was given to colleagues or head-teachers in the schools about the participants' stress readings.

In accordance with Principle 8 in the British Psychological Society (BPS): Code of Ethics participants were informed that if using the GSR caused any problems to them in front of their student, emotionally or physically, then they had the right to withdraw. There were no requests to withdraw. Tutors were asked if observing them while teaching in the classroom would cause any problems, and no one said that it would; instead they were happy to be involved in the study. In case of problems occurring during the study, it was made clear to the participants that they had the right not to participate again and were told that it is the responsibility of the researcher to make sure that their data, including recordings, must be destroyed (according to Principle 6.2 of the BPS, 2002; Point 13. of the Revised Ethical Guidelines for Educational Research, [BERA], 2004).

In the questionnaire (see Appendix D), the required information about the aims of the study and the researcher's institute was provided. Participants were informed that all the information in the questionnaire would be confidential. They were not asked to give any personal details such as names or information about their schools, and they were provided with the researcher's e-mail in case they wished to know about the results of the study.

The researcher believes that great demands might have been made on the teachers, and that although they did not actually complain, it was felt that they were being imposed upon by the researcher. Despite attempts to ensure that the observations did not impact classroom behaviour, in fact classrooms were, to some extent, disrupted; this potentially could have a negative impact on students' learning.

# Chapter Six

## THE SURVEY

### *6.1. Introduction*

The survey is designed to investigate whether there is any relationship between the use of technology and stress - i.e. establishing the existence of technostress in the classroom. It is intended to obtain teacher's views on technostress, their experience of the causes and the symptoms of technology-related stress, and their coping strategies. The survey consists of a set of questions related to a number of demographic characteristics and a number of subscales – as stated in the previous chapter - and was adapted from the work and comments of Goldberg and Williams (1988); Henderson, (2006); Hudiburg, (1996); Weil and Rosen, (1997); Kupersmith, (1998); Kirsh, (2000); World Health Organization (WHO), (2004).

Those respondents whose scores indicate poor general health, high levels of psychological distress, low levels of social interaction, and/or high levels of perceived stress will be excluded from the main part of the study. From the 136 questionnaire distributed to 14 institutions in London (five secondary school, five primary schools, and four CLCs), only 119 questionnaires were accepted; After dropping 22 cases for the above reasons, 97 participants remained whose data were used in the analysis. Excluding these people with high levels of general stress will allow the researcher to identify more clearly specific subjective environmental variables (TEs) and teacher variables (Ts), that might lead to lack of fit of the teacher in the technology supported classroom and thus might be associated with technostress.

The aim of this chapter is to analyse the data from the closed questions and from the open-ended questions presented in the survey. The findings will be used together with the findings from the classroom investigation in the next chapter. The findings in this chapter will help to establish the existence of technostress and the relationship between some variables (age, gender, attitude, use of technology). The chapter will show that there are relationships between the variables age, attitude and use of technology, and relationships between these variables and the responses of the teachers.

This chapter consists of six sections. Descriptive statistics will be summarised in section 6.2, showing evidence that 'technological problems' networking problems' 'more demands' and 'information overload' are the main reported causes of technostress, and 'bad temper' 'mental fatigue' and 'headaches' are the main reported symptoms of technostress. An analysis of the relationship between causes of technostress will attempt to identify related groups of variables that may correspond to the elements of complexity. The section will show also evidence of a significant relationship between the variables of age, attitude, and time of use but will find no evidence of significant relationship between variables of gender, kind of school, attitude and amount of use. Section 6.3 will summarise the relationship between the reported causes of technostress and age, gender, attitude, and time of use. It will show that whilst gender and kind of school appear not to be related with technostress, that age, attitude, and time of use may well be related to technostress. Section 6.4 will find no evidence of relationships between the reported symptoms of technostress and age, gender, attitude, and time of use. The responses to the open-ended questions will be analyzed in section 6.5. It will explain how the coded causes were categorised under the headings technology problems; time wasting; lack of support; pupils' misuse of technology in the classroom; teachers' lack of training, and negative attitude. This section shows that about half of the data coded as causes could also be coded as forms of complexity (i.e. either workload or unpredictability), and this supports the suggestion that the concept of complexity may be a useful one in discussing aspects of the causes of technostress. The section will show the coded symptoms that were categorised under three headings, used from the literature, namely, physical, psychological, and behavioural symptoms. Some examples about each symptom will be presented. The section will show that some symptoms such as frustration were found to be important symptoms in that they were agreed upon by many teachers. In addition, it will show that those who reported problem-focused coping strategies were more in number than those who reported emotion-focused strategies, suggesting the possibility of managing the technostress phenomenon.

## 6.2. Descriptive statistics

### 6.2.1. Demographic Data, Attitude Towards, and Use of Technology

Table 14 shows the age and the gender of the participants[5].

| | | Age | | | | Total |
|---|---|---|---|---|---|---|
| | | 18-25 | 26-35 | 36-50 | 51 or older | |
| Gender | Male | 5 | 5 | 7 | 3 | 20 |
| | Female | 14 | 21 | 34 | 7 | 76 |
| | Total | 19 | 26 | 41 | 10 | 96 |

**Table 14: Age and Gender**

More than 55% of respondents were secondary school teachers, 28% were primary school teachers, and 16% were from community learning centres (CLC) (see Table 15). Regarding the attitude towards technology, more than 77% teachers reported having a positive attitude towards technology, and 23% avoid, or watchfulness, or do not love to use technology, even though they reported that they had to use it (see Table 16).

| Type of School | Primary | | Secondary | | CLC | | Other | |
|---|---|---|---|---|---|---|---|---|
| | 27 | 28% | 53 | 55% | 16 | 16% | 1 | 1% |

**Table 15: Type of school**

| Attitude towards Technology | Love Technology | | Watchfulness | | Avoid Technology | | Do not love Technology | |
|---|---|---|---|---|---|---|---|---|
| | 75 | 77% | 8 | 8% | 1 | 1% | 13 | 14% |

**Table 16: Attitude towards technology**

Table 17 shows the amount of use of technology each day by the participants.

| Hours per Day | Less than one Hour | 1-3 Hours | 4-6 Hours | More than Six Hours |
|---|---|---|---|---|
| General Use | 3% | 24% | 40% | 33% |
| For Education | 15% | 45% | 27% | 8% |

**Table 17: Amount of use of technology**

[5] The values do not always add up to 97, and the percentages do not always add up to 100 because of missing values – which range in number from 1 to 21.

59% of the participants think that technological devices they use are easy to use because they have learned how to use them; 15% think that technological devices are difficult to use because they are complicated; 5% think that they are simple to use; more than 10% think that technological devices are easy to use because they have learned about them, and because they think that technology are generally simple to use. Table 18 shows to what extent technostress was considered as problematic by participants.

| Technostress | Not a Serious Problem | Somewhat Serious | Serious | Very Serious Problem | No Idea |
|---|---|---|---|---|---|
| % | 8 | 53 | 21 | 6 | 11 |

**Table 18: Experience of technostress**

Asked whether their level of stress due to the use of technology had increased during the month preceding the survey, 19% of teachers said yes, 65% reported little change, 3% reported that their level of technostress has decreased, and 12% reported that they 'no idea'.

The 97 teachers who participated in the survey generally had good health (unsurprisingly since all those with very poor health had been excluded from the analysis), and of the 97 participants, 85% reported that they had had no accident or injury that required medical attention in the previous year; and 14% reported that they had accident or injury that required medical attention. 69% reported that they had no serious life events that caused stress to them during the last year and 31% reported that they had experienced a serious life event that caused stress. Their GHQ scores indicated that they were experiencing good health during the last month, which suggests that their responses to the survey probably would not be affected to a great degree by the life events or accidents they had experienced in the last year. The current marital status questions showed that 2% of the participants were separated, 4% were divorced, 1% were widowed, 68% were married or cohabiting, and 25% had never married.

### *6.2.2. Technostress-Causes*

Fifteen stressors were listed in the survey. The teachers were asked to answer the following question: "From the list below, what are the main causes of technostress for you? Indicate by ticking the appropriate box (high, medium, low, nil)." Table 19 shows the frequency of reporting of these causes of technostress.

| Causes | | Frequency (Mode) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | High | | Medium | | Low | | Nil | |
| 1 | Information | 21 | 22% | 32 | 33% | 20 | 21% | 17 | 18% |
| 2 | More work required | 20 | 21% | 30 | 31% | 31 | 32% | 11 | 11% |
| 3 | New learning required | 18 | 19% | 34 | 35% | 30 | 31% | 9 | 9% |
| 4 | More demands | 23 | 24% | 32 | 33% | 25 | 26% | 12 | 12% |
| 5 | Too much change | 16 | 17% | 33 | 34% | 25 | 26% | 15 | 16% |
| 6 | Technology | 52 | 54% | 27 | 28% | 10 | 10% | 2 | 2% |
| 7 | Technology physical problems | 9 | 9% | 14 | 14% | 37 | 38% | 29 | 30% |
| 8 | Networking | 27 | 28% | 31 | 32% | 29 | 30% | 6 | 6% |
| 9 | Security issues | 8 | 8% | 35 | 36% | 30 | 30% | 17 | 18% |
| 10 | Application software | 3 | 3% | 22 | 23% | 38 | 39% | 27 | 28% |
| 11 | Web sites | 2 | 2% | 21 | 22% | 43 | 44% | 22 | 23% |
| 12 | Complexity | 11 | 11% | 25 | 26% | 38 | 39% | 16 | 17% |
| 13 | Multi-tasking | 6 | 6% | 27 | 28% | 37 | 38% | 22 | 23% |
| 14 | Compatibility | 11 | 11% | 27 | 28% | 34 | 35% | 19 | 20% |
| 15 | Uncertainty | 13 | 13% | 35 | 36% | 33 | 34% | 11 | 11% |

**Table 19: Causes of technostress (n=97)**

The table above shows the modal frequency for each cause in yellow. The stressors that are most commonly reported as high causes of stress are 'technology problems' (54%), followed by 'networking problems' (28%), 'more demands' (24%) and then 'information overload' (22%). The stressors that were least commonly reported as high causes of stress are 'Web sites' and 'application software'.

If the modal frequency rating is assigned to each cause, then the following results will be obtained:

HIGH

6- Technology problems

MEDIUM

15- Uncertainty

9- Security issues

3- New learning required

5- Too much change

4- More demands

1- Information overload

8- Networking problems

LOW

11- Web sites

10- Application software

12- Complexity

7- Technology physical problems

13- Multi-tasking

14- Compatibility

2- More work required

If the responses of the 22 excluded teachers were added back in, then the results remain largely unchanged, with changes to the mode for 'new learning required' and 'networking problems'. Table 20 shows the detailed results.

| | Causes | Frequency (Mode) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | High | | Medium | | Low | | Nil | |
| 1 | Information overload | 28 | 23% | 37 | 31% | 25 | 21% | 22 | 18% |
| 2 | More work required | 29 | 24% | 34 | 29% | 36 | 30% | 15 | 13% |
| 3 | New learning required | 25 | 21% | 38 | 32% | 39 | 33% | 11 | 9% |
| 4 | More demands | 30 | 25% | 40 | 34% | 27 | 23% | 17 | 14% |
| 5 | Too much change | 19 | 16% | 45 | 38% | 28 | 23% | 19 | 16% |
| 6 | Technology problems | 67 | 56% | 33 | 28% | 11 | 9% | 2 | 2% |
| 7 | Technology physical | 12 | 10% | 20 | 17% | 47 | 39% | 32 | 27% |
| 8 | Networking problems | 39 | 33% | 34 | 29% | 33 | 28% | 9 | 8% |
| 9 | Security issues | 13 | 11% | 39 | 33% | 37 | 31% | 23 | 19% |
| 10 | Application software | 4 | 3% | 29 | 24% | 44 | 37% | 35 | 29% |
| 11 | Web sites | 2 | 2% | 28 | 23% | 52 | 44% | 28 | 23% |
| 12 | Complexity | 12 | 10% | 29 | 24% | 50 | 42% | 21 | 18% |
| 13 | Multi-tasking | 7 | 6% | 31 | 26% | 43 | 36% | 32 | 27% |
| 14 | Compatibility | 12 | 10% | 35 | 29% | 42 | 35% | 24 | 20% |
| 15 | Uncertainty | 14 | 12% | 45 | 38% | 40 | 34% | 15 | 13% |

**Table 20: Causes of technostress (n=119)**

Table 21 shows the correlations between the causes reported in the survey. The table has been marked up to show the more substantial relationships (with a correlation of

0.6 or more) in yellow, and low and moderate relationships (between 0.4 and 0.5) in green.

Looking first just at the relationships shown in yellow, three groups of inter-related variables are seen:

a) More work required, more demands, too much change, new learning required (with new learning required also correlating to complexity)
b) Multi-tasking, compatibility, uncertainty and complexity
c) Web-sites and application software

Group (c) is probably easy enough to understand – they both relate to the software elements of computer systems. Groups (a) and (b) are more interesting and show some relationships with the concept of complexity that was discussed in Chapters 3 and 4. This concept of complexity as explained there is wider in scope than the use of the word 'complexity' presented as one of the options in the list of causes within the questionnaire and which is explained there as 'the degree of difficulty that is perceived in terms of understanding or usage of technology'. There some of the causes of technostress were categorised under three aspects of complexity, namely workload, unpredictability and simultaneity. Group (a) would seem to relate to workload, and group (b) to relate to unpredictability and simultaneity.

Looking at the correlations shown in green, the large number of correlations in the lower left corner of the table points to a moderate level of correlation between the two groups of variables (a) and (b). These relationships, on one hand, lend support to the idea that there are clusters of causes that could reasonably be called 'complexity', and, on the other hand, perhaps question the division between unpredictability and simultaneity.

| | Information overload | More work required | New learning required | More demands | Too much change | Technology problems | Technology physical problems | Networking problems | Security issues | Application software | Web sites | Complexity | Multi -tasking | Compatibility | Uncertainty |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Information overload | 1 | | | | | | | | | | | | | | |
| More work required | 0.497 | 1 | | | | | | | | | | | | | |
| New learning required | 0.546 | 0.61 | 1 | | | | | | | | | | | | |
| More demands | 0.448 | 0.707 | 0.722 | 1 | | | | | | | | | | | |
| Too much change | 0.571 | 0.484 | 0.693 | 0.633 | 1 | | | | | | | | | | |
| Technology problems | 0.254 | 0.119 | 0.356 | 0.366 | 0.368 | 1 | | | | | | | | | |
| Technology physical | 0.318 | 0.087 | 0.255 | 0.185 | 0.374 | 0.301 | 1 | | | | | | | | |
| Networking problems | 0.234 | 0.18 | 0.328 | 0.334 | 0.21 | 0.517 | 0.271 | 1 | | | | | | | |
| Security issues | 0.37 | 0.257 | 0.401 | 0.286 | 0.366 | 0.353 | 0.393 | 0.411 | 1 | | | | | | |
| Application software | 0.293 | 0.28 | 0.252 | 0.235 | 0.277 | 0.178 | 0.388 | 0.206 | 0.436 | 1 | | | | | |
| Web sites | 0.4 | 0.367 | 0.426 | 0.33 | 0.253 | 0.216 | 0.347 | 0.25 | 0.488 | 0.739 | 1 | | | | |
| Complexity | 0.395 | 0.466 | 0.671 | 0.583 | 0.582 | 0.345 | 0.296 | 0.235 | 0.32 | 0.401 | 0.454 | 1 | | | |
| Multi-tasking | 0.454 | 0.445 | 0.526 | 0.519 | 0.579 | 0.295 | 0.399 | 0.112 | 0.312 | 0.523 | 0.548 | 0.606 | 1 | | |
| Compatibility | 0.484 | 0.453 | 0.562 | 0.524 | 0.494 | 0.39 | 0.332 | 0.287 | 0.399 | 0.423 | 0.562 | 0.551 | 0.734 | 1 | |
| Uncertainty | 0.487 | 0.414 | 0.569 | 0.386 | 0.542 | 0.402 | 0.464 | 0.248 | 0.432 | 0.381 | 0.396 | 0.61 | 0.635 | 0.645 | 1 |

**Table 21: Correlation Matrix (causes)**

### *6.2.3. Technostress-Symptoms*

The survey asked the participants whether they had experienced a range of symptoms listed under three headings: physical symptoms, psychological symptoms (including both cognitive and affective symptoms), and behavioural symptoms. Also there were some open-ended questions which enabled the participants to add any other symptoms they experienced when they use technology. Symptoms that were added by participants will be analysed later. Table 22 shows the frequency of the symptoms reported.

| | Symptoms | Frequency | |
|---|---|---|---|
| | | N | % |
| | **Physical symptoms** | | |
| 1 | Muscle tension | 34 | 35 |
| 2 | Rapid heartbeat | 6 | 6 |
| 3 | Headaches | 34 | 35 |
| | **Psychological symptoms** | | |
| 4 | Mental fatigue | 40 | 41 |
| 5 | Inability to concentrate | 25 | 26 |
| 6 | Poor judgment | 5 | 5 |
| 7 | Anxiety | 17 | 18 |
| 8 | Depression | 3 | 3 |
| 9 | Bad temper | 57 | 59 |
| | **Behavioral symptoms** | | |
| 10 | Avoidance | 11 | 11 |
| 11 | Withdrawal | 9 | 9 |
| 12 | Insomnia | 12 | 12 |

**Table 22: Symptoms of technostress (n=97)**

As shown in Table 22 the most frequently reported symptoms were as the following:

7- Bad temper (59 %) - a psychological symptom

2- Mental fatigue (41 %) - a psychological symptom

3- Headaches (35 %) - a physical symptom

1- Muscle tension (35%) - a physical symptom

5- Inability to concentrate (26 %) - a psychological symptom

7- Anxiety (18 %) - a psychological symptom

Interestingly, behavioural symptoms were not frequently reported by the teachers.

Adding the responses of the 22 excluded teachers made no important difference – see Table 23.

| | Symptoms | Frequency N | Frequency % |
|---|---|---|---|
| | **Physical symptoms** | | |
| 1 | Muscle tension | 43 | 36 |
| 2 | Rapid heartbeat | 12 | 10 |
| 3 | Headaches | 48 | 40 |
| | **Psychological symptoms** | | |
| 4 | Mental fatigue | 54 | 45 |
| 5 | Inability to concentrate | 33 | 28 |
| 6 | poor judgment | 9 | 8 |
| 7 | Anxiety | 24 | 20 |
| 8 | Depression | 6 | 5 |
| 9 | Bad temper | 72 | 60 |
| | **Behavioural symptoms** | | |
| 10 | Avoidance | 19 | 16 |
| 11 | Withdrawal | 11 | 9 |
| 12 | Insomnia | 22 | 18 |

**Table 23: Symptoms of technostress (n=119)**

The researcher also looked at the correlation matrix for symptoms, but they are not reported since there was nothing over 0.5.

### *6.2.4. Age, Gender, Kind of School, Attitude Towards, and Use of Technology*

It is possible that there is a relationship between age/gender, kind of school, attitude and amount of use, so before starting on further analysis it is worth looking at this. The use of the chi-square test with the original data was often inappropriate since the expected value of a number of cells was below 5; therefore some frequencies were combined in order to avoid such problems. For age variable 18-25 and 26-35 were combined in one group (i.e., 18-35) and 36-50 and 51 or more in another group (i.e., 36 or more). For attitude variable, those who love to use technology were put in one group and the others (those who do not love or watchfulness or avoid using technology) in another group. Also for the use of technology variable those who use technology for less than one hour and those who use it 1-3 hours were combined in one group (i.e. 0-3) and those who use it 4-6 hours and those who use it 6 or more hours in another group (i.e. 4 and more hours). Table 24 below shows significant relationship between age and amount of time using technology everyday for education as the value of chi-square exceeded 3.8, the critical value for $p<0.05$ for 1df. Table 24 shows also that teachers of age 36 or more seem to use technology less in time than those of age 18-35. Table 25 below shows significant relationship between age and attitude towards technology as the value of chi-square exceeded 3.8, the critical value for $p<0.05$ for 1df, after applying Yates's correction for continuity. Also Table 25 shows that teachers of 36 or more are more likely to hold negative attitude than those of age 18-35.

| Age | Use of Technology for Education Everyday | | | | Chi-square | |
|---|---|---|---|---|---|---|
| | 0-3 hours | | 4 and more hours | | Value | df |
| 18-35 | 22 | 52% | 21 | 48% | 5.198 | 1 |
| 36 or more | 37 | 73% | 13 | 27% | | |

**Table 24: Age and amount of time using technology everyday for educational purposes**

| Age | Attitude towards Technology | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | Love to use Technology | | Do not Love or Watchfulness or Avoid Using Technology | | Value | df | |
| 18-35 | 40 | 89% | 5 | 11% | 6.407 | 1 | 5.235 |
| 36 or more | 35 | 67% | 17 | 33% | | | |

**Table 25: Age and attitude towards technology**

Looking at the relationship between gender and attitudes towards technology, and between gender and amount of time using technology everyday for education shows no significant relationships as the values of chi-square did not exceed 3.8, the critical value for $p<0.05$ for 1df, after applying Yates's correction for continuity where necessary (see Tables 26 and 27 below).

| Gender | Attitude towards Technology | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | Love to use Technology | | Do not Love or Watchfulness or Avoid Using Technology | | Value | df | |
| Male | 16 | 80% | 4 | 20% | 0.122 | 1 | .002 |
| Female | 58 | 76% | 18 | 24% | | | |

**Table 26: Gender and attitude towards technology**

| Gender | Use of Technology for Education Everyday | | | | Chi-square | |
|---|---|---|---|---|---|---|
| | 0-3 Hours | | 4 and More Hours | | Value | df |
| Male | 13 | 69% | 6 | 31% | .297 | 1 |
| Female | 45 | 61% | 28 | 39% | | |

**Table 27: Gender and amount of time using technology everyday for educational purposes**

No relationships were found between kind of school (primary and secondary) and attitudes towards technology, and between kind of school (primary and secondary) and amount of time using technology everyday for education as the values of chi-square did not exceed 3.8, the critical value for $p<0.05$ for 1df, after applying Yates's correction for continuity where necessary (see Tables 28 and 29 below).

| Kind of school | Attitude towards Technology | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | Love to Use Technology | | Do not love or Watchfulness or Avoid Using Technology | | Value | df | |
| Primary | 23 | 85% | 4 | 15% | 1.797 | 1 | 1.129 |
| Secondary | 38 | 72% | 15 | 28% | | | |

**Table 28: Kind of school and attitude towards technology**

| Kind of School | Use of Technology for Education Everyday | | | | Chi-square | |
|---|---|---|---|---|---|---|
| | 0-3 Hours | | 4 and More Hours | | Value | df |
| Primary | 16 | 64% | 9 | 36% | .011 | 1 |
| Secondary | 32 | 63% | 19 | 37% | | |

**Table 29: Kind of school and amount of time using technology everyday for educational purposes**

Table 30 below shows a significant relationship between attitude towards technology and amount of time using technology everyday for education as the value of chi-square exceeded 3.8, the critical value for $p<0.05$ for 1df, after applying Yates's correction for continuity. Those who hold positive attitude towards technology seem to use the technology more than those who hold negative attitude towards technology, it might be that those who use technology for longer become familiar with the use of technology and therefore they hold positive attitudes towards it, or conversely that those with positive attitudes towards the technology end up using it more.

| Attitude Towards Technology | Use of Technology for Education Everyday | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | 0-3 Hours | | 4 and More Hours | | Value | df | |
| Love to Use Technology | 40 | 56% | 31 | 44% | 6.529 | 1 | 5.298 |
| Do not Love or Watchfulness or Avoid Using Technology | 19 | 89% | 3 | 11% | | | |

**Table 30: Attitude towards technology and amount of time using technology everyday for educational purposes**

### *6.2.5. Discussion*

The results of the analyses of the sample used in this study (97 teachers) did not change very much when the data of the excluded 22 teachers was added - this was also true for analyses of the relationship to causes and symptoms, which the researcher did not report here. The reason might be that this excluded sub-group, did not in fact differ substantially in their responses to technostress from the main group contrary to the researcher's expectations, or that the number of additional participants was not large enough to substantially change the overall results. The researcher will not, therefore, report any further on analyses involving the full data set included the 22 excluded teachers.

A rather unscientifically caricature the typical respondent based on the data shown above might be that the respondent is female, aged 36-50, working in a secondary school, use technology 1-3 hours a day, and actually likes technology. Her main stressor is technology problems, and her main symptom of stress is bad temper.

The results above show statically significant relationships between age, attitude and the amount of time using technology everyday for education, though they show no significant relationship between gender and kind of school and attitude and amount of use. It seems to have a group of teachers over 35 (both men and women) with negative attitudes towards technology who use it rather little. However the researcher must not exaggerate the degree of differences; some 27% of this older group use technology 4 or more hours a day (compared with 48% of their younger colleagues), and 67% have a positive attitude to technology (compared with 89% of their younger colleagues).

The next section will discuss the correlation between demographic characteristics and attitude towards and use of technology, and the causes and symptoms of technostress.

## 6.3. Relationship between Demographic Characteristics, Attitude Towards, and Use of Technology and the Causes of Technostress

This section examines whether there was any relation between gender, age, kind of school and attitude towards technology and the reported causes of technostress.

### 6.3.1. Gender and the Causes of Technostress

In order to see whether there was a relation between gender and the reported causes of technostress, chi-square tests were used as shown in Table 31. The use of the chi-square test with the original data was often inappropriate since the expected value of a number of cells was below 5; therefore, some frequencies were combined in order to avoid such problems. High or medium scores of each cause were combined in one group, and low or nil scores of each cause were combined in another group. The researcher also applied the Yates's correction for continuity where necessary. Doing so showed no statically significant relationship for 15 of the causes, but a significant relationship for the item 'too much change' where the value of chi-square exceeded 3.8, the critical value for $p<0.05$ for 1df. Table 32 shows that females were very slightly more likely than males to rate 'too much change' as high, much more likely to rate it as medium, and much less likely to rate it as low or nil.

| Cause | Gender | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | Male | | Female | | | | |
| | High or Medium | Low or Nil | High or Medium | Low or Nil | Value | df | |
| Information overload | 9 | 9 | 43 | 28 | .66 | 1 | Not required |
| More work required | 9 | 9 | 40 | 33 | 0.134 | 1 | Not required |
| New learning required | 7 | 11 | 45 | 27 | 3.291 | 1 | Not required |
| More demands | 11 | 8 | 44 | 28 | 0.065 | 1 | Not required |
| Too much change | 4 | 14 | 45 | 25 | 10.266 | 1 | Not required |
| Technology problems | 16 | 3 | 62 | 9 | 0.126 | 1 | .001 |
| Technology physical problems | 6 | 12 | 17 | 53 | .607 | 1 | .229 |
| Networking problems | 12 | 7 | 46 | 27 | 000 | 1 | Not required |
| Security issues | 7 | 11 | 35 | 36 | .624 | 1 | Not required |
| Application software | 5 | 13 | 19 | 52 | .008 | 1 | .044 |
| Web sites | 5 | 13 | 17 | 52 | .075 | 1 | .001 |
| Complexity | 8 | 10 | 27 | 44 | .248 | 1 | Not required |
| Multi-tasking | 8 | 11 | 25 | 47 | .355 | 1 | Not required |
| Compatibility | 7 | 11 | 31 | 41 | .102 | 1 | Not required |
| Uncertainty | 9 | 10 | 38 | 34 | .176 | 1 | Not required |

**Table 31: Gender and the causes of technostress**

| Cause | | Gender | | | |
|---|---|---|---|---|---|
| | | Male | % | Female | % |
| Too Much Change | High | 3 | 17 | 13 | 19 |
| | Medium | 1 | 5 | 32 | 46 |
| | Low | 9 | 50 | 15 | 21 |
| | Nil | 5 | 28 | 10 | 14 |

**Table 32: Too much change and gender**

### *6.3.2. Age and the Causes of Technostress*

This section investigates the relation between age and the reported causes of technostress. The use of the chi-square test with the original data was often inappropriate since the expected value of a number of cells was below 5; therefore some frequencies were combined in order to avoid such problems. The age groups were combined to make two groups (18-35 group and 36 or more group); also, cause scores were combined to two groups (high or medium scores and low or nil scores). Table 33 below shows that there were differences for the five causes: 'new learning required', 'more demands' 'too much change', 'technology physical problems', and 'security issues' as the value of chi-square exceeded 3.8, the critical value for $p<0.05$ for 1df - shown in yellow colour - for these five factors. The percentages of the age groups of the reported five factors are shown in Table 34. Teachers age 36 or older classified 'new learning required', 'more demands' 'too much change', 'technology physical problems', and 'security issues' as high more often than the 18-35 age group.

| Cause | Age | | | | Chi-square | |
|---|---|---|---|---|---|---|
| | 18-35 | | 36 or More | | | |
| | High or Medium | Low or Nil | High or Medium | Low or Nil | Value | df |
| Information overload | 21 | 21 | 32 | 16 | 2.57 | 1 |
| More work required | 19 | 24 | 31 | 18 | 3.36 | 1 |
| New learning required | 19 | 24 | 33 | 15 | 5.588 | 1 |
| More demands | 20 | 22 | 35 | 15 | 4.756 | 1 |
| Too much change | 17 | 25 | 32 | 15 | 6.833 | 1 |
| Technology problems | 32 | 9 | 47 | 15 | .069 | 1 |
| Technology physical problems | 10 | 32 | 13 | 3 | 15.975 | 1 |
| Networking problems | 22 | 21 | 36 | 34 | .001 | 1 |
| Security issues | 16 | 26 | 27 | 14 | 6.403 | 1 |
| Application software | 10 | 32 | 15 | 21 | 2.838 | 1 |
| Web sites | 10 | 32 | 13 | 33 | .225 | 1 |
| Complexity | 14 | 28 | 22 | 26 | 1.458 | 1 |
| Multi-tasking | 12 | 30 | 21 | 29 | 1.789 | 1 |
| Compatibility | 13 | 29 | 25 | 24 | 3.745 | 1 |
| Uncertainty | 19 | 23 | 29 | 21 | 1.49 | 1 |

**Table 33: Age and the causes of technostress**

| Causes | | Age | | | |
|---|---|---|---|---|---|
| | | 18-35 | % | 36 or Older | % |
| New learning required | high | 5 | 12 | 13 | 32 |
| | medium | 14 | 32 | 20 | 41 |
| | low | 18 | 41 | 12 | 23 |
| | nil | 6 | 15 | 3 | 4 |
| More demands | high | 7 | 16 | 16 | 43 |
| | medium | 13 | 31 | 19 | 35 |
| | low | 14 | 33 | 11 | 13 |
| | nil | 8 | 20 | 4 | 5 |
| Too much change | high | 3 | 8 | 13 | 38 |
| | medium | 14 | 32 | 19 | 39 |
| | low | 14 | 33 | 11 | 18 |
| | nil | 11 | 27 | 4 | 5 |
| Technology physical problems | high | 4 | 11 | 5 | 14 |
| | medium | 6 | 14 | 8 | 25 |
| | low | 16 | 38 | 21 | 40 |
| | nil | 16 | 37 | 13 | 21 |
| Security issues | high | 2 | 5 | 6 | 11 |
| | medium | 14 | 33 | 21 | 42 |
| | low | 17 | 41 | 13 | 36 |
| | nil | 9 | 21 | 8 | 11 |

**Table 34: New learning required, more demands, too much change, technology physical problems, security issues and age**

### *6.3.3. Kind of School and the Causes of Technostress*

Investigating the relationship between type of school and the reported causes of technostress showed no statistically significant relationships between type of school (secondary, primary, CLC and others) and causes of technostress as the values of the chi-square did not exceed 16.9, the critical value for $p<0.05$ for 9df. The researcher was primarily interested in investigating the relationship between causes of technostress and secondary and primary schools, so the researcher did break the chi-square into 2x2 chi-square tests (see Table 35). Accordingly, the levels of significance would be changed from 5% and divided between six chi-squares (sharing the 5% between the six comparisons); the adjusted value of the chi-square to be significant is 6.96 (see, Howitt and Cramer, 2005, pp. 142-143). The researcher also applied the Yates's correction for continuity where necessary. Table 35 shows no significant relationship between kind of school (primary and secondary) and causes of technostress, as none of the values exceeded 7.48, the adjusted value of the chi-square for $p<0.05$ for 1df.

| Causes | Kind of School | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | Primary | | Secondary | | Value | df | |
| | High or Medium | Low or Nil | High or Medium | Low or Nil | | | |
| Information overload | 22 | 5 | 24 | 22 | 6.27 | 1 | Not required |
| More work required | 15 | 12 | 28 | 20 | .055 | 1 | Not required |
| New learning required | 17 | 10 | 26 | 21 | .412 | 1 | Not required |
| More demands | 16 | 11 | 29 | 19 | .01 | 1 | Not required |
| Too much change | 16 | 11 | 24 | 21 | .24 | 1 | Not required |
| Technology problems | 24 | 3 | 39 | 9 | .75 | 1 | .29 |
| Technology physical problems | 7 | 20 | 11 | 34 | .02 | 1 | Not required |
| Networking problems | 17 | 10 | 33 | 16 | .149 | 1 | Not required |
| Security issues | 17 | 10 | 21 | 25 | 2.043 | 1 | Not required |
| Application software | 10 | 17 | 13 | 33 | .607 | 1 | Not required |
| Web sites | 11 | 15 | 10 | 35 | 3.192 | 1 | Not required |
| Complexity | 13 | 14 | 18 | 28 | .566 | 1 | Not required |
| Multi-tasking | 12 | 15 | 16 | 32 | .912 | 1 | Not required |
| Compatibility | 11 | 16 | 21 | 25 | .167 | 1 | Not required |
| Uncertainty | 15 | 12 | 26 | 22 | .013 | 1 | Not required |

**Table 35: Kind of school (primary and secondary) and the causes of technostress**

### *6.3.4. Attitude Towards and Use of Technology and the Causes of Technostress*

The chi-square test was used to investigate the relationship between teachers' attitude towards technology and the reported causes of technostress (Table 36). The use of the chi-square test with the original data was often inappropriate since the expected value of a number of cells was below 5; therefore some frequencies were combined in order to avoid such problems. The attitude groups were combined into two groups (love to use technology and do not love or watchfulness or avoid using technology) also cause scores were combined to two groups (high or medium scores and low or nil scores). In addition, the Yates's correction for continuity was applied where necessary. Significant relationships were found for 'more work required', 'new learning required', 'more demands' and 'too much change' (the value of chi-square exceeded 3.8, the critical value for $p<0.05$ for 1df). The significant relationships are highlighted in yellow. Teachers who reported that they 'do not love or watchfulness or avoid using technology' classified 'more work required', 'new learning required', 'more demands' and 'too much change' as high more often than those who love using technology (see yellow colour in Table 37 below).

| Cause | Attitudes towards Technology | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | Love to Use Technology | | Do not Love or Watchfulness or Avoid Using Technology | | | | |
| | High or Medium | Low or Nil | High or Medium | Low or Nil | Value | df | |
| Information overload | 39 | 30 | 14 | 7 | .684 | 1 | Not required |
| More work required | 33 | 37 | 17 | 5 | 6.125 | 1 | Not required |
| New learning required | 35 | 35 | 17 | 4 | 6.319 | 1 | Not required |
| More demands | 38 | 33 | 17 | 4 | 5.072 | 1 | Not required |
| Too much change | 32 | 38 | 17 | 2 | 11.565 | 1 | Not required |
| Technology problems | 59 | 11 | 20 | 1 | 1.693 | 1 | .871 |
| Technology physical problems | 19 | 51 | 4 | 15 | .289 | 1 | .059 |
| Networking problems | 41 | 30 | 17 | 5 | 2.728 | 1 | Not required |
| Security issues | 29 | 41 | 14 | 8 | 3.316 | 1 | Not required |
| Application software | 17 | 53 | 8 | 12 | 1.915 | 1 | Not required |
| Web sites | 15 | 54 | 8 | 18 | .839 | 1 | Not required |
| Complexity | 22 | 48 | 14 | 6 | 1.857 | 1 | Not required |
| Multi-tasking | 23 | 48 | 10 | 11 | 1.633 | 1 | Not required |
| Compatibility | 26 | 44 | 12 | 9 | 2.657 | 1 | Not required |
| Uncertainty | 33 | 37 | 15 | 7 | 2.969 | 1 | Not required |

**Table 36: Attitudes and the causes of technostress**

| Causes | | Attitudes towards Technology | | | |
|---|---|---|---|---|---|
| | | Love to Use Technology | % | Do not Love or Watchfulness or Avoid Using Technology | % |
| More work required | High | 11 | 16 | 9 | 57 |
| | Medium | 22 | 31 | 8 | 25 |
| | Low | 26 | 37 | 5 | 18 |
| | Nil | 11 | 16 | 0 | 0 |
| New learning required | High | 10 | 14 | 6 | 39 |
| | Medium | 25 | 36 | 9 | 44 |
| | Low | 26 | 37 | 4 | 17 |
| | Nil | 9 | 13 | 0 | 0 |
| More demands | High | 14 | 20 | 9 | 58 |
| | Medium | 24 | 34 | 8 | 29 |
| | Low | 21 | 29 | 4 | 13 |
| | Nil | 12 | 17 | 0 | 0 |
| Too much change | High | 12 | 17 | 4 | 20 |
| | Medium | 20 | 29 | 13 | 68 |
| | Low | 23 | 33 | 2 | 11 |
| | Nil | 15 | 21 | 0 | 0 |

**Table 37: More work required, new learning required, more demands, too much change and attitude towards technology**

Table 38 shows that teachers who hold negative attitudes towards technology are more likely to rate all of the causes of technostress as 'high' than those who hold positive attitudes towards technology.

| Causes | | Attitude towards Technology | |
|---|---|---|---|
| | | Teachers who Love to Use Technology | Do not Love or Watchfulness or Avoid Using Technology |
| Information overload | High | 22% | 50% |
| More work required | High | 16% | 57% |
| New learning required | High | 14% | 39% |
| More demands | High | 20% | 58% |
| Too much change | High | 17% | 20% |
| Technology problems | High | 51% | 80% |
| Technology physical problems | High | 10% | 17% |
| Networking problems | High | 24% | 61% |
| Security issues | High | 6% | 43% |
| Application software | High | 3% | 4% |
| Web sites | High | 1% | 4% |
| Complexity | High | 6% | 33% |
| Multi-tasking | High | 4% | 38% |
| Compatibility | High | 10% | 12% |
| Uncertainty | High | 11% | 14% |

**Table 38: Attitude towards technology and causes of technostress reported as 'high'**

Table 39 below shows causes of technostress and amount of time of use of technology for educational purpose every day. The use of the chi-square test with the original data was often inappropriate since the expected value of a number of cells was below 5; therefore, some frequencies were combined to avoid such problems. The use of technology groups were combined into two groups (0-3 hours group and 4 or more hours group) also cause scores were combined into two groups (high or medium scores and low or nil scores). Also the Yates's correction for continuity was applied where necessary. Significant relationship was found only for 'security issues' (the value of chi-square exceeded 3.8, the critical value for $p<0.05$ for 1df). The significant relationship was highlighted in yellow. It was shown that teachers who reported that they 'use technology less than 3 hours' classified 'security issues' as high more often than those who use technology '4 hours or more' (see yellow colour in Table 40).

| Cause | Use of Technology for Education Everyday | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | 0-3 Hours | | 4 or More Hours | | | | |
| | High or Medium | Low or Nil | High or Medium | Low or Nil | Value | df | |
| Information overload | 31 | 24 | 21 | 11 | .722 | 1 | Not required |
| More work required | 29 | 28 | 21 | 11 | 1.811 | 1 | Not required |
| New learning required | 42 | 24 | 19 | 13 | .167 | 1 | Not required |
| More demands | 33 | 23 | 20 | 12 | 1.108 | 1 | Not required |
| Too much change | 30 | 24 | 18 | 14 | .004 | 1 | Not required |
| Technology problems | 50 | 6 | 26 | 5 | .53 | 1 | .153 |
| Technology physical problems | 13 | 41 | 8 | 24 | .009 | 1 | Not required |
| Networking problems | 33 | 23 | 21 | 11 | .385 | 1 | Not required |
| Security issues | 31 | 24 | 11 | 21 | 3.917 | 1 | Not required |
| Application software | 18 | 37 | 6 | 26 | 1.978 | 1 | Not required |
| Web sites | 14 | 39 | 8 | 24 | .021 | 1 | Not required |
| Complexity | 22 | 33 | 13 | 23 | .139 | 1 | Not required |
| Multi-tasking | 19 | 37 | 12 | 20 | .114 | 1 | Not required |
| Compatibility | 23 | 33 | 14 | 18 | .06 | 1 | Not required |
| Uncertainty | 30 | 27 | 16 | 15 | .008 | 1 | Not required |

**Table 39: The reported use of technology for education everyday and causes of technostress**

| Cause | | Use of Technology for Education Everyday | | | |
|---|---|---|---|---|---|
| | | 0-3 Hours | % | 4 or More Hours | % |
| Security issues | High | 6 | 15 | 1 | 4 |
| | Medium | 25 | 43 | 10 | 41 |
| | Low | 13 | 20 | 16 | 46 |
| | Nil | 11 | 22 | 5 | 9 |

**Table 40: Security issues and amount of time using technology**

Table 41 below shows that those who use technology for longer are less likely to report many causes of technostress as high.

| Causes | | Use of Technology for Education Everyday | |
|---|---|---|---|
| | | 0-3 Hours | 4 or More Hours |
| Information overload | High | 19% | 31% |
| More work required | High | 30% | 20% |
| New learning required | High | 25% | 25% |
| More demands | High | 29% | 21% |
| Too much change | High | 32% | 19% |
| Technology problems | High | 33% | 17% |
| Technology physical problems | High | 22% | 27% |
| Networking problems | High | 32% | 18% |
| Security issues | High | 43% | 7% |
| Application software | High | 50% | 0% |
| Web sites | High | 25% | 25% |
| Complexity | High | 32% | 18% |
| Multi-tasking | High | 42% | 8% |
| Compatibility | High | 28% | 23% |
| Uncertainty | High | 35% | 16% |

**Table 41: The reported use of technology and the reported causes of technostress as 'high'**

### *6.3.5. Discussion*

This section found no significant relationships between kind of school and the causes of technostress, but there were significant relationships between the other demographic characteristics (gender, age) use of and attitude towards technology and the likelihood of labelling particular causes of technostress as 'high or medium'. The significant relationships between age, attitude, and amount of using technology influence the reported causes of technostress, and suggest that older teachers, teachers who hold negative attitudes, and those who use technology less in time do experience more stress.

The main relationships are shown in the Table 42 below: some of these causes could be seen as related, with change requiring new learning, more demands and more work, and this perhaps being of particular concern to teachers over 35 and those with negative attitudes towards technology. Interestingly, security was a concern for teachers over 35 and those who only used technology only a little, perhaps implying either that security concerns discouraged these teachers from using technology or that their lack of familiarity with technology engendered security concerns.

| More Likely to Rate a Cause as 'High or Medium' | Too Much Change | New Learning Required | More Demands | More Work Required | Technology Physical Problems | Security Issues |
|---|---|---|---|---|---|---|
| Gender | Female | | | | | |
| Age | ≥36 | ≥36 | ≥36 | | ≥36 | ≥36 |
| Attitude | Negative | Negative | Negative | Negative | | |
| Amount of Use | | | | | | 0-3 hours |

**Table 42: Gender, age, attitude, amount of use and the reported causes as 'high' or 'medium'**

Further evidence of links is found in the fact that 32% of teachers who hold negative attitudes towards technology reported their level of stress increased, whereas only 18% of teachers who hold positive attitude towards technology reported their level of technostress increased during the previous month. Those who use technology for longer are less likely to label many causes of technostress as 'high'.

Possibly the older age group were less likely to have experience themselves at school of technology, whereas those of age 18-35 were more familiar with technology. Attitude and amount of use of technology show that those who love technology use it more in time than those who do not or watchfulness or avoid using it; moreover those who use technology longer reported less stress. It is impossible to tell which – stress, attitude or the use - is cause and which is effect. Maybe liking technology means that it does not cause an individual stress, or maybe the fact that technology does not cause an individual stress causes him/her to like it. Maybe technostress causes people to use technology less, or maybe using technology less means an individual is not so experienced and so he/she is more likely to be stressed.

## 6.4. Relationship between Demographic Characteristics, Attitude Towards, and Use of Technology and the Symptoms of Technostress

This section discusses the relationship between gender, age, kind of school and attitude towards and amount of use of technology with reported symptoms of technostress.

### 6.4.1. Gender and the Symptoms of Technostress

To see if there is difference between the reporting of the symptoms of technostress by men and women the chi-square test was used. It is clear in Table 43 below that there was no evidence that they were giving different responses. The chi-square values do not exceeded the value of 3.8, the critical value for $p<0.05$ for 1df, after applying Yates correction where necessary.

| Symptoms | Gender | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | Male | | Female | | Value | df | |
| | Y | N | Y | N | | | |
| **Physical symptoms** | | | | | | | |
| Muscle Tension | 6 | 12 | 28 | 42 | .268 | 1 | Not required |
| Rapid Heartbeat | 3 | 15 | 3 | 67 | 3.455 | 1 | Not required |
| Headaches | 6 | 12 | 28 | 42 | .268 | 1 | Not required |
| **Psychological symptoms** | | | | | | | |
| Mental Fatigue | 9 | 11 | 31 | 38 | .000 | 1 | Not required |
| Inability to Concentrate | 5 | 15 | 20 | 49 | .122 | 1 | Not required |
| Poor Judgment | 3 | 17 | 2 | 67 | 4.282 | 1 | 2.304 |
| Anxiety | 2 | 18 | 15 | 58 | 1.169 | 1 | 0.57 |
| Depression | 0 | 20 | 3 | 70 | .849 | 1 | 0.043 |
| Bad Temper | 11 | 9 | 46 | 27 | .425 | 1 | Not required |
| **Behavioural symptoms** | | | | | | | |
| Avoidance | 1 | 17 | 10 | 58 | 1.068 | 1 | 0.405 |
| Withdrawal | 3 | 15 | 6 | 62 | .934 | 1 | 0.285 |
| Insomnia | 4 | 14 | 8 | 60 | 1.296 | 1 | 0.572 |

**Table 43: Gender and the symptoms of technostress**

### 6.4.2. Age and the Symptoms of Technostress

This section investigates whether the age of the participants was associated with reporting their experience of the symptoms of technostress. The use of the chi-square test with the original data was often inappropriate since the expected value of a number of cells was below 5; therefore, some frequencies were combined in order to avoid such problems. The age groups were combined to two groups (18-35 group and 36 or more group). Table 44 shows that the chi-square values (applying Yates correction as necessary) for four symptoms 'muscle tension', 'mental fatigue', 'bad temper', and 'insomnia', exceeded 3.8, the critical value for $p<0.05$ for 1df (shown in yellow colour). This indicated significant relationship between these four symptoms and the age factor. Teachers of age 36 and above more often reported that they experienced 'muscle tension', 'mental fatigue', 'bad temper', and 'insomnia' more than 18-35 age group (see yellow colour in Table 45 below).

| Symptoms | Age | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | 18-35 | | 36 & More | | | | |
| | Y | N | Y | N | Value | df | |
| **Physical Symptoms** | | | | | | | |
| Muscle Tension | 12 | 32 | 23 | 23 | 4.888 | 1 | Not required |
| Rapid Heartbeat | 2 | 41 | 4 | 42 | .578 | 1 | .114 |
| Headaches | 14 | 29 | 20 | 26 | 1.123 | 1 | Not required |
| **Psychological Symptoms** | | | | | | | |
| Mental Fatigue | 14 | 30 | 26 | 20 | 5.558 | 1 | Not required |
| Inability to Concentrate | 11 | 33 | 14 | 32 | .331 | 1 | Not required |
| Poor Judgment | 0 | 44 | 5 | 41 | 5.064 | 1 | 3.204 |
| Anxiety | 6 | 38 | 11 | 39 | 1.105 | 1 | Not required |
| Depression | 0 | 44 | 3 | 47 | 2.727 | 1 | 1.131 |
| Bad Temper | 22 | 22 | 35 | 15 | 3.922 | 1 | Not required |
| **Behavioural Symptoms** | | | | | | | |
| Avoidance | 3 | 39 | 8 | 37 | 2.225 | 1 | Not required |
| Withdrawal | 4 | 38 | 5 | 40 | .059 | 1 | .012 |
| Insomnia | 1 | 41 | 11 | 34 | 8.894 | 1 | Not required |

**Table 44: Age and the symptoms of technostress**

| Symptoms | Age | | | |
|---|---|---|---|---|
| | 18-35 | % | 36 or Older | % |
| Muscle Tension | 11 | 25 | 23 | 64 |
| Mental Fatigue | 14 | 34 | 26 | 59 |
| Bad Temper | 22 | 49 | 35 | 77 |
| Insomnia | 1 | 4 | 11 | 20 |

**Table 45: Muscle tension, mental fatigue, bad temper, and insomnia and age**

### *6.4.3. Kind of School and the Symptoms of Technostress*

This part shows the relationship between the kind of school a teacher taught in and their reported symptoms. The questionnaire included secondary, primary, CLC, and other. Investigating the relationship with these types showed no significant relationship between reported symptoms and kind of school. The values of the chi-square for the symptoms of technostress did not exceed the 7.8, the critical value for $p<0.05$ for 3df. However, because there was some uncertainty about the relationship and because the researcher was particularly interested in the relationship between symptoms of technostress and two types of school (secondary and primary), the researcher did break the chi-square into 2x2 chi-square tests (see Table 46). Accordingly, the levels of significance would be changed from 5% and divided between six chi-squares (sharing the 5% between the six comparisons), in this case the adjusted value of the chi-square to be significant is 6.96 (see Howitt and Cramer, 2005, pp. 142-143). Nevertheless, Table 46 shows no significant relationship between kind of school (primary and secondary) and symptoms of technostress.

| Symptoms | Kind of School | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | Primary | | Secondary | | Value | df | |
| | Y | N | Y | N | | | |
| **Physical Symptoms** | | | | | | | |
| Muscle Tension | 11 | 13 | 19 | 29 | .257 | 1 | Not required |
| Rapid Heartbeat | 0 | 24 | 4 | 44 | 2.118 | 1 | .827 |
| Headaches | 8 | 16 | 19 | 29 | .267 | 1 | Not required |
| **Psychological Symptoms** | | | | | | | |
| Mental Fatigue | 16 | 11 | 19 | 29 | 2.688 | 1 | Not required |
| Inability to Concentrate | 7 | 20 | 13 | 35 | .012 | 1 | Not required |
| Poor Judgment | 2 | 25 | 3 | 45 | .037 | 1 | .084 |
| Anxiety | 4 | 23 | 10 | 42 | .238 | 1 | .031 |
| Depression | 0 | 27 | 2 | 50 | 1.065 | 1 | .077 |
| Bad Temper | 21 | 6 | 29 | 23 | 3.705 | 1 | Not required |
| **Behavioural Symptoms** | | | | | | | |
| Avoidance | 3 | 20 | 8 | 41 | .13 | 1 | 0 |
| Withdrawal | 3 | 20 | 5 | 44 | .128 | 1 | .002 |
| Insomnia | 5 | 18 | 5 | 44 | 1.741 | 1 | .91 |

**Table 46: Kind of school (secondary and primary) and the symptoms of technostress**

### *6.4.4. Attitude Towards and Use of Technology and the Symptoms of Technostress*

In Table 47 below, the values of chi-square for 'headaches', 'anxiety', and 'avoidance' after applying Yates's correction for continuity exceeded 3.8, the critical value for p<0.05 for 1df, (shown in yellow colour). Therefore, these symptoms showed a significant relationship with attitudes towards technology. Teachers who reported that they 'do not love or watchfulness or avoid using technology' reported that they experienced 'headaches', 'anxiety', and 'avoidance' as a symptom of technostress more than those who love using technology (see yellow colour in Table 48 below).

| Symptoms | Attitude towards Technology: Love to use technology | | Attitude towards Technology: Do not love or watchfulness or avoid using technology | | Chi-square | | Chi-square with Yates's correction for continuity |
|---|---|---|---|---|---|---|---|
| | Y | N | Y | N | Value | df | |
| **Physical Symptoms** | | | | | | | |
| Muscle Tension | 24 | 45 | 10 | 10 | 1.521 | 1 | Not required |
| Rapid Heartbeat | 3 | 66 | 3 | 17 | 2.798 | 1 | 1.361 |
| Headaches | 20 | 46 | 14 | 6 | 10.118 | 1 | Not required |
| **Psychological Symptoms** | | | | | | | |
| Mental Fatigue | 27 | 41 | 12 | 7 | 3.302 | 1 | Not required |
| Inability to Concentrate | 19 | 49 | 6 | 13 | 0.096 | 1 | Not required |
| Poor Judgment | 2 | 66 | 3 | 16 | 4.526 | 1 | 2.465 |
| Anxiety | 8 | 61 | 9 | 13 | 9.436 | 1 | Not required |
| Depression | 2 | 67 | 1 | 21 | .0142 | 1 | .096 |
| Bad Temper | 39 | 30 | 17 | 5 | 3.035 | 1 | Not required |
| **Behavioural Symptoms** | | | | | | | |
| Avoidance | 4 | 60 | 7 | 14 | 10.294 | 1 | 8.031 |
| Withdrawal | 6 | 58 | 3 | 18 | 0.403 | 1 | .051 |
| Insomnia | 7 | 57 | 5 | 16 | 2.161 | 1 | 1.23 |

**Table 47: Attitudes and the symptoms of technostress**

| Symptoms | Attitude towards Technology: Love Technology | | Attitude towards Technology: Do not love or Watchfulness or Avoid Using Technology | |
|---|---|---|---|---|
| Headaches | 20 | 29% | 14 | 79% |
| Anxiety | 8 | 11% | 9 | 41% |
| Avoidance | 4 | 6% | 7 | 52% |

**Table 48: Headaches, anxiety, and avoidance and attitude towards technology**

Table 49 shows the relationship between the reported symptoms and the amount of use of technology for education purpose every day. Significant relationship was found only for 'mental fatigue' (the value of chi-square exceeded 3.8, the critical value for $p<0.05$ for 1df). It was shown that teachers who reported that they 'use technology less than 3 hours' reported mental fatigue more often than those who use technology '4 hours or more' (see yellow colour in Table 50 below).

| Symptoms | Use of Technology for Education Everyday | | | | Chi-square | | Chi-square with Yates's Correction for Continuity |
|---|---|---|---|---|---|---|---|
| | 0-3 Hours | | 4 or More Hours | | | | |
| | Y | N | Y | N | Value | df | |
| **Physical Symptoms** | | | | | | | |
| Muscle Tension | 23 | 31 | 9 | 22 | 1.543 | 1 | Not required |
| Rapid Heartbeat | 5 | 49 | 0 | 31 | 3.05 | 1 | 1.607 |
| Headaches | 22 | 32 | 12 | 19 | .034 | 1 | Not required |
| **Psychological Symptoms** | | | | | | | |
| Mental Fatigue | 30 | 25 | 8 | 23 | 6.64 | 1 | Not required |
| Inability to Concentrate | 13 | 42 | 10 | 21 | .752 | 1 | Not required |
| Poor Judgment | 3 | 52 | 1 | 30 | .222 | 1 | .004 |
| Anxiety | 11 | 47 | 5 | 27 | .157 | 1 | Not required |
| Depression | 2 | 56 | 1 | 31 | .007 | 1 | .283 |
| Bad Temper | 35 | 23 | 20 | 12 | .04 | 1 | Not required |
| **Behavioural Symptoms** | | | | | | | |
| Avoidance | 9 | 45 | 2 | 27 | 1.567 | 1 | .832 |
| Withdrawal | 6 | 48 | 2 | 27 | .385 | 1 | .053 |
| Insomnia | 6 | 48 | 5 | 24 | .617 | 1 | .199 |

**Table 49: Use of technology for education everyday and symptoms**

| Symptoms | Use of Technology for Education Everyday | | | |
|---|---|---|---|---|
| | 0-3 Hours | | 4 or More Hours | |
| Mental Fatigue | 30 | 49% | 8 | 26% |

**Table 50: Mental fatigue and use of technology for education everyday**

Table 51 shows that those who use technology longer reported 'inability to concentrate', 'bad temper', and 'insomnia' more often than those who reported that they use technology less than three hours a day, whereas the majority of symptoms were reported more often by those who use technology less than three hours a day.

| Symptoms | Use of Technology for Education Everyday | |
|---|---|---|
| | 0-3 Hours | 4 or More Hours |
| **Physical Symptoms** | | |
| Muscle Tension | 36% | 28% |
| Rapid Heartbeat | 11% | 0% |
| Headaches | 46% | 39% |
| **Psychological Symptoms** | | |
| Mental Fatigue | 49% | 25% |
| Inability to Concentrate | 28% | 30% |
| Poor Judgment | 6% | 2% |
| Anxiety | 21% | 15% |
| Depression | 3% | 2% |
| Bad Temper | 56% | 66% |
| **Behavioural Symptoms** | | |
| Avoidance | 17% | 5% |
| Withdrawal | 10% | 5% |
| Insomnia | 11% | 26% |

**Table 51: The reported use of technology for education everyday and symptoms of technostress**

### *6.4.5. Discussion*

This section showed that there were significant relationships between age, attitude towards, and use of technology, and some symptoms of technostress (namely, muscle tension, headaches, mental fatigue, anxiety, bad temper, avoidance, and insomnia). There were no significant relationships between gender, kind of school, and symptoms of technostress. Teachers of age 36 and more reported muscle tension, mental fatigue, bad temper and insomnia more than 18-35 age group. There were significant relationships between symptoms of technostress and attitude in three symptoms: headaches, anxiety, and avoidance. Those with a negative attitude towards technology unsurprisingly reported anxiety and avoidance as symptoms, although there is no obvious reason why they also reported headaches. The main relationships are shown in the Table 52 below.

Generally, males and females seem to be sharing almost the same symptoms, as there were no different between what they have reported. Teachers from different kinds of schools reported that they shared the same symptoms. Teachers of age 36 and more seem to be the most at risk than the others, and it is obvious that they experience some symptoms more often than younger group. Moreover, those with a negative attitude seem to be at risk than those who hold a positive attitude towards technology, and it is perhaps obvious that they would experience symptoms such as avoidance more often than others do. Teachers who reported that they use technology more in time than other teachers were less stressed – as they reported few symptoms of technostress - than those who use technology less in time.

It is interesting to compare the frequency of reporting the main symptoms of technostress by those who positive and negative attitudes to technology, even where these did not reach the level of statistical significance. The four symptoms of muscle tension, headaches, mental fatigue, and bad temper were the four most commonly reported symptoms (as shown earlier in Table 22). The main relationships are shown in the Table 52 below.

| | Physical Symptoms | | Psychological Symptoms | |
|---|---|---|---|---|
| **Most Frequently Reported symptoms of Stress** | **Muscle Tension** | **Headaches** | **Mental Fatigue** | **Bad Temper** |
| **Positive Attitude** | 35% | 29% | 39% | 56% |
| **Negative Attitude** | 51% | 79% | 75% | 84% |

**Table 52: Attitude and the most frequently reported symptoms of technostress**

It was expected that age might have significant relationship with symptoms of technostress but there was no a priori reason to expect other relationships. It was stated in the second chapter that individual responded in different manners to the same stressor, and his/her response might change due to the time. This concept was expected to be found in this study, so a significant relationship between some factors and symptoms of technostress could not be found. It is understood that reporting causes is influenced by factors such as experience, attitude, etc. as the decision depends upon the perception of the individual about the event and about his/herself, whereas experiencing symptoms might not be influenced by some factors. For example, an individual might report the same cause in different time and reported experiencing different behavioural symptoms. Therefore, it was accepted that some variables do not have a unique role that influences individual's response to stressor (symptom), and thus it was obvious not to find a link between variables per se, and between such variables and the reported symptoms.

## 6.5. Responses to the Open-ended Questions

The survey contains some open-ended questions in which participants were asked to write about: kinds of technology they use, the causes, the symptoms, and the methods they use to cope with such causes of stress.

The significance of this section lies in the additional information provided by the participants. The description of causes, symptoms, and coping strategies in the participants' own words lends greater credence to the idea that technostress is a significant issue for these teachers.

NVivo was used to support the analysis of the open-ended questions. The theory used in this study leaded the researcher to expect: (a) the following categories: causes, symptoms, and coping; and (b) that some causes might be related to complexity. The categories were formed into some open-ended questions in the survey. There were no open-ended questions about complexity, but the researcher looked for data in answers to the causes question, such data was examined, and if it appeared to relate to complexity, then it was coded under a child of complexity. Accordingly four nodes were set up, i.e. data in answer to the cause question was coded at child nodes of cause node and some were also coded at child nodes of the complexity node; data in answer to symptoms question was coded only at child nodes of symptoms node; data in answer to coping question was coded only at child nodes of coping node. Each node had several child nodes, and so the researcher coded at child nodes rather than at the parent nodes. To generate a child node the researcher examined the data in each node – for the nodes symptoms and coping, the researcher knew in advance their child nodes, so if the data appeared to relate to the child node then it was coded under such child node (e.g. headache was related directly to the physical child node). Whereas data in the cause node was examined and categorised under different child codes according to the number of times it was reported (e.g., different errors were reported many times so they were coded under a child node, which was named as technological problems). It was difficult to use the causes factors that were discussed in the literature review as child nodes. The literature discussed many different factors some were related to the organisational factors, other were related to the job characteristics and some were related to personal characteristics (see section 3.2). When the data was examined and when looked at the factors under the job characteristics and personal characteristics, it was found that they were to some extent different. So it was inappropriate to use all the factors in the literature as child nodes for causes. Yet, some of the factors in the literature were similar to what have been found in the data in this study for example technological problems, technical support. Therefore, the following way was used to categorise the causes child nodes: first the researcher put all units related to causes together, and then he read through these units and highlighted the repeated units. It was found that there were five commonly repeated units. For example many factors were related to pupils; so the researcher put one category with the name pupils, other units were related to technological problems, other were related to time wasting, some were related to lack of support, and some others were related to teachers. Accordingly, five child nodes were generated under the causes node namely; technological problems, time wasting, support, pupils, and teachers. The researcher's decisions about assigning the data to a certain node or a child node were based upon the definition made of each node and/or child node in accordance with insights derived from the literature review (more about each node will be explained below). It sometimes happened that no data was found at a theoretically constructed node, for example, the complexity node consists of three types, but two types were only found in the data. In adopting such an approach, this did not cover all the data, there were sections of the data that were coded under different free nodes; for example, kinds of technology used. Using NVivo sixteen tree nodes were coded as shown in Figure 3, which consists of four nodes (i.e. causes, symptoms, coping, and complexity) and 12 child nodes.

**Tree Nodes**

| Name | Sources | References |
|---|---|---|
| causes | 0 | 0 |
| technological problems | 1 | 41 |
| time wasting | 1 | 10 |
| lack of support | 1 | 48 |
| pupil | 1 | 2 |
| teachers | 1 | 66 |
| complexity | 0 | 0 |
| unpredictability | 1 | 8 |
| workload | 1 | 15 |
| symptoms | 0 | 0 |
| physical | 1 | 14 |
| psychological | 1 | 17 |
| behavioral | 1 | 14 |
| coping | 0 | 0 |
| problem-focused | 1 | 65 |
| emotion-focused | 1 | 40 |

**Figure 3: Responses to open-ended questions (tree nodes)**

One free node was about the kind of technology; the survey did not specifically mention many kinds of technology. Some kinds were listed, and participants were asked about other kinds they might use. Participants sometimes referred to different kinds of technology, and this indicates the level of experience of some teachers regarding technology. Technologies mentioned included: interactive whiteboard (IWB), wireless laptop, Student Information Management System (SIMS), digital video, digital camera, Computer Aided Design (CAD) and Computer Aided Manufacture (CAM), graphics tablet, scanner, DVD player/recorder.

The following sections will discuss the main nodes used to code the responses to the open-ended questions.

### *6.5.1. Causes of Stress*

Causes in this study are conceptualised as situations of lack of fit between the teacher and the technological environment of the classroom. This node included five child nodes namely: technological problems; time wasting, lack of support; pupils (that is factors related to students' misuse of technology in the classroom) and teachers (that is factors that were related to the teachers' misuse of technology, and to lack of qualifications). These are shown in Table 53 below. This section of analysis of responses to the open-ended questions in the survey will be taken together with section 7.3.2 where we consider the evidence related to causes from the classroom investigation to provide a fuller discussion of the place of causes of technostress in section 8.3.

| **Causes** (5 child nodes, 167 units) | **Lack of Fit** (Demand-Ability & Supply-Need forms) | **Subjective environment factors (TEs)** | **Subjective Teacher factors (Ts)** |
|---|---|---|---|
| **Technological problems** (41 units) | D-A form | Errors to be fixed | Inability to fix errors |
| **Time wasting** (10 units) | D-A form | Preparing, installing technology | Inability to control |
| **Lack of support** (48 units) | S-N form | No or delayed technical support | Need for technical support |
| **Pupils** (2 units) | D-A form | Explaining the use of technology to pupils, or fixing errors caused by pupils | Inability to deal with the problems related to student's use of technology |
| **Teachers** (66 units) | D-A form | Technology skill required | Lack of required technology skill |

**Table 53: Causes (open-ended)**

In Table 53, 167 units[6] were coded as 'causes' at child nodes: technology problems, time wasting, lack of support, pupils, and teachers.

[6] A 'unit' is a section of text that was coded at one child node. It has no specific length, it might be a whole paragraph, part of a paragraph, a sentence, a phrase or a word. Using the pre-defined nodes and the categories, we looked carefully at the text, and then highlighted segments of the text we think were related to the given nodes. We read the segments again and limited the length of the excerpt we highlighted. For example some extracts of the text included a symptom (e.g., frustration) so the word frustration was highlighted and the other words around it were excluded from the extract text, and so this becomes a unit. In this example, it was coded under 'psychological symptoms child node'. Some segments of the text were more than one word; for example, a sentence where a participant describes his/her strategies of coping saying that 'I seek help from my colleagues' so the complete sentences was highlighted as a unit and was coded under 'problem-focused coping child node'. In these two examples, our understanding of the definition of each code and child code, which we gain from the literature review, was used to define the limit of the unit or the quotation coded. Some other segments were longer for example those explained an event experienced by the participant. Deleting some of the words or sentences in the segments would affect the point explained, so we regarded the complete excerpt as a single unit.

Technological problems were frequently reported by participants and included factors such as errors, and faults (41 units). Examples were such as one participant who stated that "although I said it was 'easy', that's only when it doesn't go wrong - generally the problems I have are not with not understanding technology. It's that correcting faults is an absolute pain". Another reported, "there are lots of benefits of technology and I'm often one of the first to want to use something new - but I do get frustrated when things don't work". In addition to the errors and faults that were reported participants asked for "reliable systems, with back-up instantly available in case of breakdown"; "technology that works consistently"; and "a more reliable computer network within ... school".

Time wasting was another factor (10 units); for example a participant expressed feelings of frustration because of "time wasted trying to use poor software". Different and frequent occurrences of problems lead to some participants to call for abandoning technology in teaching. They suggested that teachers should "get kids to read books" or they should "get rid of technology. Go back to how it used to be. A blackboard and chalk", and at least one recommended "much less use of computers and more use of books for teaching".

Some participants reported 'lack of support', and reported that technical support and social support are necessary for them to use technology with confidence in the classroom; see, for example, the following statements from the open-ended questions: "ICT technicians support so that any system or equipment problems are not the teacher's responsibility". One participant stated that "technical support i.e. an always and immediately available person to come and sort out hiccups". Another reported that "full-time technicians in school to deal with the techie side so that teachers can get on with using the technology to teach instead of trying to fix it". One participant stated, "in a previous school, technology support and systems were excellent so I had no problems using the technology available in every lesson of the day if needed but that is not the case now".

Some factors were related to 'pupils', and can be seen for example in statement such as "school need someone to take charge of IT across the curriculum to ensure all students get a range of IT experiences and that work in one subject is built on in another".

Some factors were related to 'teachers' i.e. 'technology skill required' by teachers (66 units). Ten units related to teachers' abilities and 56 related to training. Misuse of technology and lack of qualification were examples of factors related to teachers' abilities. Lack of skill led teachers to report experience of stress when they use technology in the classroom. For example, one participant admitted the feeling of "anger, mainly with myself for not being able to figure a way around the problem. It isn't the technology that's at fault – it's my knowledge of it that's the weak link! That said I have been known to spend hours figuring out how to do what it is I want to do. I'm also willing to admit defeat and seek help". Another teacher reported, "I think that most people who suffer from technostress suffer because they don't really know what they're doing". Another participant agreed with this statement, saying "one of the big problems for teachers is that they do not possess the skills necessary to use technology. Many are scared of making mistakes and some are still under the impression that they can practically 'blow up the PC' if they make an error ... and the only technostress I get comes from having an endless amount of little tasks to do for other teachers who are unsure of how to do something. When the head rings me up (we are a split site) to ask me how to put a table in Word I feel like screaming". The most problematic factor reported by the participants was the need for training. They emphasised the benefits of teachers taking some courses about technology and practising new software they may use in their classrooms. Examples about the training factor were seen in the following statements "bad temper is the result of frustration at being expected to just 'pick up' how to use new technology - in my case an interactive whiteboard with no formal training whatsoever. Then being told that since I have one in my room I will be expected to use it when I am observed despite having NO training and NO time allocated for me to learn about this technology". Another teacher stated that "currently, teachers are expected to cope with advancing technology, but many have never been given the time to learn about it. NOF[[7]] was a waste of time and no other time or money has been spent on training since. This should be a major government initiative". Another statement was "better

[7] New Opportunities Fund training, a UK centrally funded scheme for training teachers in using ICT to support learning from 1999 to 2003 (see, Preston, 2004)

training available for teachers who are not involved in ICT directly. Time should be set aside for ICT teachers to work with other staff rather than just the pupils. This will reduce the stress as the more comfortable people are with using the technology, the less stress"; also, "providing training for those teachers who struggle with their knowledge of computers would probably solve the problem. Training teachers to use computers efficiently will also increase the creativity and imagination brought to their lesson planning".

### *6.5.2. Complexity*

Complexity in this study related to specific changes, namely those related to workload, unpredictability and simultaneity in job characteristics, due to implementation of the technology in classroom, which leads teachers to experience physical and psychological problems. Some causes were related to some types of complexity (see chapters 3 and 4), so the researcher wanted to know if it is possible to find this in technological classroom, and thus this section will be taken together with section 7.3.3 where we consider the complexity types from the classroom investigation in order to provide a fuller discussion of the place of complexity in technological classroom in section 8.4. Some of the data given in answer to the cause question was additionally coded at two separate child nodes of 'complexity' node. The two child nodes were 'unpredictability' and 'workload'. Table 54 below shows the child nodes under the main complexity node. Unpredictability examples were things such as "can't really say other than it happens quite regularly that the computer does not work as it should and it's usually at a crucial time!!", "I get very flustered when I am trying to photocopy stuff for lessons, have set aside what I consider to be sufficient time in which to do it and then the copier jams". Some examples of workload were such as "in terms of stress - VERY STRESSFUL since I end up having to do far more work in my own time than should be necessary", "it depends, some time I am very happy - when my model of educational applications with ICT works, but some time I am stressed when I have a lot of work to do", "having to put in extra hours in my own time when I should be in bed", "I am excited about learning new ways to enrich the curriculum using ICT, not spending hours trying to fix network problems"

| | |
|---|---|
| **Complexity** (2 child nodes 23 units) | **Workload** (15 units) |
| | **Unpredictability** (8 units) |

**Table 54: Complexity (open-ended)**

Of the 167 units coded at one of the child nodes of 'causes', just 23 were also coded at child nodes of 'complexity', Table 55 below shows the distribution of these units. 11 units coded as 'technological problems' such as fixing errors were also coded as the 'workload' type of complexity. Three units coded as 'time wasting', - for example preparing technology - added load to teachers, so were coded as the 'workload' type of complexity. One unit coded as 'pupil' – i.e. teaching students how to use technology – was also coded as the 'workload' type of complexity. Eight units coded as 'technological problems' such as errors were also coded as the 'unpredictability' type of complexity.

| | **Complexity** | | **Other** |
|---|---|---|---|
| | **Workload** | **Unpredictability** | |
| **Causes** (5 child nodes, 167 units) | **15 units** | **8 units** | **144 units** |
| **Technological problems** (41 units) | 11 | 8 | 22 |
| **Time wasting** (10 units) | 3 | | 7 |
| **Lack of support** (48 units) | | | 48 |
| **Pupil** (2 units) | 1 | | 1 |
| **Teachers** (66 units) | | | 66 |

**Table 55: Complexity and causes (open-ended)**

### *6.5.3. Symptoms of Stress*

Symptoms in this study refer to the physical, psychological and/or behavioural changes experienced by an individual when respond to stimuli. This node had three child nodes: (a) physical symptoms, (b) psychological symptoms, and (c) behavioural symptoms, as shown in Table 56. This section will be taken together with section 7.3.4 where we consider the evidence related to symptoms from the classroom investigation in order to provide a fuller discussion of the place of symptoms of the technostress in section 8.5.

| | |
|---|---|
| **Symptoms** (3 child nodes, 45 units) | **Physical symptoms** (14 units) (13 teachers) |
| | **Psychological symptoms** (17 units) (14 teachers) |
| | **Behavioral symptoms** (14 units) (12 teachers) |

**Table 56: Symptoms (open-ended)**

Examples of physical symptoms included; Repetitive Strain Injury (RSI), migraine, shortness of breath, lethargy, tiredness, hot flushing, eye strain, back ache, shoulder blades, and raising of blood pressure. Psychological symptoms included feelings of frustration, irritation, annoyance, and anger. These four psychological symptoms were not included in the list of psychological symptoms in the survey, and frustration was the most reported symptom, in response to this open-ended question – being given by 10 participants. Behavioural symptoms included: shouting, moaning, and leaving technology.

### *6.5.4. Coping*

Coping refers to strategies used by an individual to deal with stress; such strategies were either dealing with stress emotionally or dealing with the problem that causes stress. In this node two child nodes were coded (a) the problem-focused, and (b) the emotion-focused, (Table 57) below. The data gained from this section will help to answer the research question related to the reported coping strategies in a technological classroom. Data from this section will be taken together with section 7.3.5 where we consider the evidence related to coping from the classroom investigation in order to provide a fuller discussion of the place of coping within the whole technostress process in section 8.6.

Examples of problem-focused were such as "I try not to rely on technology so that if it goes wrong I have a backup plan", "learn as much as I can about the IT equipment and software I'm using before bringing it into the classroom to check for incompatibilities", "I train up and use the resources at home so that I am confident", "phone Techs for support or ask colleagues. At home discuss with IT Consultant". Whereas examples of emotion-focused strategies were such as "sense of humour", "I actually love technology. I just try to keep calm and to be honest I am used to it I think!", "physiotherapy and yoga. As head of a department with a new team of inexperienced staff, I stress to them that they only need to use the technology as a teaching tool when they feel confident and competent to do so. As a teacher with 33 years experience, if everything goes pear-shaped, I resort to the good old-fashioned methods used prior to the explosion in technology. I regularly mix-and-match new and old methods", "pen and paper, shout at children daft enough to ignore my dark warnings", "turn the PC off and have a cup of tea".

| | |
|---|---|
| **Coping** (2 child nodes, 105 units) | **Problem-focused coping** (65 units) |
| | **Emotion-focused coping** (40 units) |

**Table 57: Coping (open-ended)**

Sixty five units were coded as 'problem-focused' and forty units for 'emotion-focused' strategies, as in Table 57 above. It was noticed that under the 'emotion-focused' there were many negative coping strategies such as: drinking too much alcohol; avoiding future use of technology; booze; another felt that leaving teaching was the right decision, reporting that coping with technology-related stress could be done by "leaving the profession. I'm in my first year". These kinds of behaviour might not help teachers to solve the problem of stress in the classroom – whatever the reason was - and it might rather increase the problem of stress. It is interesting to note that teachers seem to have been quite open in expressing the problems that they experienced with the technology, and in reported their ways of coping with technostress.

### *6.5.5. Discussion*

Those who responded to the open-ended questionnaire reported some additional causes and symptoms of technostress, and coping strategies to deal with it over and above those they responded to in the closed questions. The causes were not mainly related to technological problems; causes mentioned related to time wasting, lack of support from the school, students' misuse of technology, and to the teachers themselves – i.e. abilities and skills required to deal effectively with technology in classroom. There were 101 units, for 84 teachers, coded to aspects of the technological environment TE (i.e., technological problems, time wasting, lack of support and/or pupils) and 66 units, for 56 teachers, coded to aspect of the teacher T (ability and training). What is important about these causes is that they were different from those listed in the questionnaire. In particular, the questionnaire had not listed causes related to pupils, and the researcher did not think that they would play any role in causing technostress to teachers. In addition, the wasting of the teacher's time as they have to prepare, fix errors, or/and teaching the functions of technology to pupils, was another factor not in the list of technostress causes. These are, therefore, useful additions to the researcher's understanding of the causes of technostress for teachers.

Some reported causes were related to two of the types of complexity identified earlier for example unexpected errors were related to the 'unpredictability' type, and teaching pupils how to use technology were related to the 'workload' type of complexity.

The reported symptoms in the open-ended questions were mainly psychological - specifically frustration, followed by physical and then behavioural symptoms. These symptoms are of interest because they were not provided as options in the questionnaire, and the 'frustration' symptom in particular was found to be an important symptom in that it was agreed upon by many teachers.

Some emotion-focused coping strategies were negative, such as drinking alcohol. Problem-focused strategies were reported more in number than the reported emotion-focused strategies.

The added factors found in the open-ended questions add to our knowledge of the factors involved, but they were broadly in line with the factors provided in the questionnaire, providing support for the findings derived from the closed questions. Causes such as pupils' misuse of technology, and time wasting were major stressors. Frustration – although was not given in the list in the questionnaire - but found to be an important symptom of technostress. This points to the value of the open-ended questions and significantly extends the understanding of what causes problems in the classroom and how they are experienced.

## 6.6. Conclusion

Although 22 teachers' data was excluded from being analysed, yet the results of the analysis did not change very much when they were added to the sample used (97 teachers). The reason might be that this excluded sub-group did not in fact differ substantially in their responses to technostress from the main group contrary to the researcher's expectations, or that the number of additional participants was not large enough to substantially change the overall results.

The descriptive analysis of the data shows that those who response to the survey in large number than the other groups were female teachers, working in secondary schools, aged 36-50, with positive attitude towards technology. Their main stressor is technology problems, and the main symptom of stress is bad temper. The data shows significant relationships between age, attitude and the amount of time using technology everyday for education, and no significant relationship between gender and kinds of school, attitude, and amount of use. In addition, the data shows that teachers aged 36 and over are more likely to hold negative attitudes towards technology and to use it less than younger teachers.

No significant relationships between kind of school and the causes of technostress were found, but there are significant relationships between age, attitude, and amount of time using technology; these three factors are related to the reported causes of technostress and suggest that older teachers, teachers who hold negative attitude, and those who use technology for less time do experience more stress. It is possible that the older age group were less likely to have experience themselves at school of technology, whereas those of ages 18-35 were more familiar with technology, but it is impossible to tell which – stress, attitude or the use - is cause and which is effect. Maybe liking technology means that it does not cause you stress, or maybe the fact that technology does not cause you stress causes you to like it. Maybe technostress causes people to use technology less, or maybe using technology less means you are not so experienced and so you are more likely to be stressed.

Teachers age 36 and more seem to be the more at risk than the others, and it is obvious that they experience some symptoms more often than younger group.

Moreover, those with negative attitudes seem to be more at risk than those who hold positive attitudes towards technology. Teachers who reported that they use technology for more time than other teachers, were less stressed – as they reported few symptoms of technostress - than those who use technology for less time.

There were no significant relationships between other factors and specific symptoms of technostress. This finding is not unexpected in that the literature indicates that such factors do not have a unique role that influences individual's response to stressors, and so one would not expect to find a link between these variables and the reported symptoms or between the symptoms themselves.

The main findings of data from the open-ended questionnaire were as follow; (a) some additional causes of stress were identified: such as students' misuse of technology, and time wasting; (b) as for the data from the closed questions, some of the reported causes identified in the open questions could be seen as being related to two of the types of complexity 'unpredictability' and 'workload', (c) some additional symptoms of stress were identified particularly frustration, which was found to be an important symptom in that it was agreed upon by many teachers; (d) the participants who reported problem-focused strategies were more in number than those who reported emotion-focused coping strategies. The identification of additional causes and symptoms points to the value of the open-ended questions in obtaining additional information, and significantly extends the understanding of what causes problems in the classroom and how they are experienced.

The data from the survey as a whole shows that technostress is a serious phenomenon, and lends support to the idea that technostress exists.

The survey suggested the importance of age in the responses of the teachers but also the relationship between this variable and the variables of attitude and use. It will therefore be useful in the classroom data to look more closely at four groups of teachers:

a) Teachers of age 35 or under; with a positive attitude to technology, who use technology a lot.

b) Teachers of age 36 or more, with a positive attitude to technology, who use technology a lot.
c) Teachers of age 35 or under, with a negative attitude, who do not use technology a lot.
d) Teachers of age 36 or more, with a negative attitude to technology, who do not use technology a lot.

An examination of the correlations between the questions about causes found inter-related variables in two groups (a) more work required, more demands, too much change, new learning required (with new learning required also correlating to complexity), and (b) multi-tasking, compatibility, uncertainty and complexity. These two groups show some relationships with the concept of complexity, where the first group would seem to relate to workload, and the second group to relate to unpredictability and simultaneity. The data from the open-ended questions also provided additional evidence of two of the types of complexity: unpredictability and workload. These findings support the suggestion that the concept of complexity may be a useful one in discussing aspects of the causes of technostress, and this is another area where the researcher will look for additional information in the classroom data.

# Chapter Seven

## THE CLASSROOM INVESTIGATION

### *7.1. Introduction*

After conducting the survey and demonstrating the existence and main features of technostress in the classroom, the plan - as described in Chapter 5 - was to go to the field to provide a more in-depth description of technostress in the classroom. The researcher wanted to discover the main causes of technostress observed or reported during interview for sessions in technological classrooms; also the researcher wanted to know what kind of symptoms accompanied such causes and how teachers coped with them. It was felt that following this approach would help to describe technostress in classroom. This investigation will be based on the theory, the model used in this study, and in addition on some concepts gained from the survey. Data from observations and interviews of the nine teachers involved in the classroom investigation were analysed in the first stage, before moving on to consider the data of just four of these teachers in the case studies.

Based on the survey four groups of teachers were proposed that might be interesting to examine in more detail:

a) Teachers of age 35 or under; with a positive attitude to technology, and who use technology a lot. (four of the nine teachers)
b) Teachers of age 36 or more, with a positive attitude to technology and who, use technology a lot. (one of the nine teachers)
c) Teachers of age 35 or under, with a negative attitude, and do not use technology a lot. (three of the nine teachers)
d) Teachers of age 36 or more, with a negative attitude to technology, and who do not use technology a lot. (one of the nine teachers)

Based on the results of the survey, groups (a) and (b) were likely to report less stress, whereas groups (c) and (d) were likely to report more stress. In this chapter, cases studies will be presented of individual teachers from each of these four groups, and these case studies will be used to throw further light on the relationship between technostress and the use of technology. Brief descriptions of the four case studies are presented below.

Teacher S is a female teacher between 30 and 35 years old, teaching in a Community Learning Centre (CLC). She likes to teach with technology and has positive and extensive experience of teaching students and teachers in how to use technology as well as its use to teach other subjects. In the observed class she was teaching teachers to use technology in the classroom. She experienced some problems with the technology while she was teaching but she looked very confident, and whatever problems arose, she tried to solve them. She described her experience of technostress as 'frustrating' rather than 'stressful', and she was aware that it was not only the technical aspects that can cause stress but also the social aspects, as failure is something that is immediately shared with the class.

Teacher P is a female teacher over 45 years old, teaching science in secondary school. She holds positive attitudes towards technology, uses technology a lot, and has extensive experience and does some software evaluation work. In her classroom she seemed to use technology without relying too much on it and appeared to be highly proficiency and confident, to take the lead and drive the technology. In the observed session she was teaching chemistry. She experienced two main problems; students' misuse of technology and some problems with the performance of the software; in the interview, she said that she experienced technostress, though her approach was always to struggle to overcome the problems as they occurred.

Teacher ST is a male physics teacher, 33 years old, with negative attitudes towards technology. In the observed lesson, he used a video recording of another teacher explaining the use of Excel for the experiment they were doing. The problems he faced in the observed session arose from the demands of some students who were not able to follow what was explained in the video. He directed students to ask for help from one another. He said that he does not use technology a lot, that IT use in teaching is new to him although he is happy to use PowerPoint. He expressed his general feelings about technology in terms of anxiety rather than stress.

Teacher R is a female teacher, over 40 years old, who teaches mathematics in a primary school. She holds negative attitudes towards technology, does not trust the use of technology and does not use it a lot. In the observed session, she taught her students add/subtract using software displayed on the IWB. She experienced some difficulty in using the software on the IWB, and sometimes she asked some of her students for help. Only a small number of problems were observed in the class, and they did make her stressed, but she said that experiencing high level of technostress was her general feelings when using technology.

This chapter consists of four sections. The first section gives some examples from the methods of data collection used (GSR counter and interview), and illustrates the kinds of data collected. The second section discusses the analysis of the data captured using the interview and the observation methods for the nine teachers who participated in the study, and it also highlights some examples of the GSR readings. The third section presents four cases studies. The fourth section brings together these early sections and identifies the most important findings.

## 7.2. The investigation Methods

Teachers were directly observed and videotaped and, at the same time, the readings of Galvanic Skin Resistance (GSR) were recorded. After this, the teachers were interviewed, and when teacher wanted to see parts of the video logs and the GSR record on the computer, these were shown to them. Nine teachers participated in this method - six female teachers and three male teachers. Approximately 32 hours (15 classes) were observed, including seven science, three mathematics, three ICT, and two business studies classes during the period from February 2005 to October 2005, (see section 5.6.5)

The way used to conduct the classroom observation and an example of one observed session were explained in Chapter 5 (see section 5.6.1).

Examples of the use of GSR and the interview will be discussed in the following sections.

### *7.2.1. GSR Readings*

The way of using the GSR was explained in chapter 5 (see section 5.6.2). Table 58 shows the conductance responses of the skin per 7 seconds in the session above for teacher S for about 13 minutes in this session.

- The baseline[8] in the GSR for this teacher was -20m.
- The table shows the time of change, the change from last readings, and changes from the baseline (-20m).
- The procedure chosen was; (1) we looked at times where there was an increase of GSR readings of 10 or more above the baseline (-20m), (2) if the change from the reading three units ago is above 5, then this was considered as a result of stress experienced, (3) if the change from the reading three units ago is less than 5, then this was considered as a chance change in the GSR, because the GSR is sensitive and small changes might be due to its sensitivity. For example, if it has been found that there was an increase in the GSR readings at 9:00 that reached 11 over the baseline, and then the researcher checked that the increase was started three readings before 9:00 and the increase between the three reading was >5, then this was considered as a sign of stress, but if the change was <5, then this was interpreted as a chance change and did not interpret it as a sign of stress, and (4) the researcher highlighted the area three readings before and after the changes indicated at (1).
- There were episodes when problems occurred with the technology (which were found from the observation and video), also at this time the GSR readings were increasing ≥10 above the baseline -20m, as shown in green.
- There were times were the GSR readings increased ≥10 above the baseline -20m, - as shown in red, but the researcher was unable to know the reasons. In addition, on some occasions with other teachers, there were times were teachers reported that they experienced stress but there were no significant change in the GSR readings.
- At the period from 00:24:40 to 00:25:36, there were significant changes in the GSR above the baseline -20m, although this did not comply with the

[8] When starting the GSR for a few seconds it shows the baseline, it could be zero, but it is different from one person to another and can be positive or negative. Therefore, the researcher used to go sometimes half an hour before the session started in order to check each teacher's baseline reading, while he/she was still in calm mode.

procedure the researcher followed yet was considered as a sign of stress, as shown in yellow.

| Time | GSR | Change from Baseline(-20) | Time | GSR | Change from Baseline(-20) | Time | GSR | Change from Baseline(-20) |
|---|---|---|---|---|---|---|---|---|
| 00:19:18 | -16 | 4 | 00:23:58 | -17 | 3 | 00:28:36 | -16 | 4 |
| 00:19:25 | -18 | 2 | 00:24:05 | -15 | 5 | 00:28:43 | -13 | 7 |
| 00:19:32 | -14 | 6 | 00:24:12 | -16 | 4 | 00:28:50 | -17 | 3 |
| 00:19:39 | -15 | 5 | 00:24:19 | -14 | 6 | 00:28:57 | -12 | 8 |
| 00:19:46 | -13 | 7 | 00:24:26 | -13 | 7 | 00:29:04 | -14 | 6 |
| 00:19:53 | -19 | 1 | 00:24:33 | -12 | 8 | 00:29:11 | -15 | 5 |
| 00:20:00 | -11 | 9 | 00:24:40 | -10 | 10 | 00:29:18 | -24 | -4 |
| 00:20:07 | -14 | 6 | 00:24:47 | -11 | 9 | 00:29:25 | -22 | -2 |
| 00:20:14 | -15 | 5 | 00:24:54 | -12 | 8 | 00:29:32 | -17 | 3 |
| 00:20:21 | -14 | 6 | 00:25:01 | -9 | 11 | 00:29:39 | -13 | 7 |
| 00:20:28 | -20 | 0 | 00:25:08 | -10 | 10 | 00:29:46 | -18 | 2 |
| 00:20:35 | -21 | -1 | 00:25:15 | -10 | 10 | 00:29:53 | -15 | 5 |
| 00:20:42 | -22 | -2 | 00:25:22 | -11 | 9 | 00:30:00 | -25 | -5 |
| 00:20:49 | -17 | 3 | 00:25:29 | -7 | 13 | 00:30:07 | -23 | -3 |
| 00:20:56 | -16 | 4 | 00:25:36 | -8 | 12 | 00:30:14 | -20 | 0 |
| 00:21:03 | -24 | -4 | 00:25:43 | -17 | 3 | 00:30:21 | -19 | 1 |
| 00:21:10 | -22 | -2 | 00:25:50 | -15 | 5 | 00:30:28 | -16 | 4 |
| 00:21:17 | -25 | -5 | 00:25:57 | -16 | 4 | 00:30:35 | -20 | 0 |
| 00:21:24 | -15 | 5 | 00:26:04 | -17 | 3 | 00:30:42 | -17 | 3 |
| 00:21:31 | -13 | 7 | 00:26:11 | -13 | 7 | 00:30:49 | -12 | 8 |
| 00:21:38 | -14 | 6 | 00:26:18 | -13 | 7 | 00:30:56 | -12 | 8 |
| 00:21:45 | -19 | 1 | 00:26:25 | -15 | 5 | 00:31:03 | -10 | 10 |
| 00:21:52 | -17 | 3 | 00:26:32 | -14 | 6 | 00:31:10 | -11 | 9 |
| 00:21:59 | -18 | 2 | 00:26:39 | -17 | 3 | 00:31:17 | -8 | 12 |
| 00:22:06 | -12 | 8 | 00:26:46 | -18 | 2 | 00:31:24 | -24 | -4 |
| 00:22:13 | -6 | 14 | 00:26:53 | -18 | 2 | 00:31:31 | -30 | -10 |
| 00:22:20 | -8 | 12 | 00:27:00 | -14 | 6 | 00:31:38 | -35 | -15 |
| 00:22:27 | -10 | 10 | 00:27:07 | -13 | 7 | 00:31:45 | -35 | -15 |
| 00:22:34 | -16 | 4 | 00:27:14 | -15 | 5 | 00:31:52 | -35 | -15 |
| 00:22:41 | -12 | 8 | 00:27:21 | -12 | 8 | 00:31:59 | -35 | -15 |
| 00:22:48 | -15 | 5 | 00:27:28 | -10 | 10 | | | |
| 00:22:55 | -16 | 4 | 00:27:35 | -13 | 7 | | | |
| 00:23:02 | -16 | 4 | 00:27:42 | -12 | 8 | | | |
| 00:23:09 | -12 | 8 | 00:27:49 | -13 | 7 | | | |
| 00:23:16 | -11 | 9 | 00:27:54 | -9 | 11 | | | |
| 00:23:23 | -9 | 11 | 00:28:01 | -15 | 5 | | | |
| 00:23:30 | -7 | 13 | 00:28:08 | -8 | 12 | | | |
| 00:23:37 | -9 | 11 | 00:28:15 | -9 | 11 | | | |
| 00:23:44 | -11 | 9 | 00:28:22 | -10 | 10 | | | |
| 00:23:51 | -15 | 5 | 00:28:29 | -17 | 3 | | | |

**Table 58: Time and GSR (Teacher S)**

Figures 4, 5, and 6 below show events occurred while a teacher was using technology; that were found from the observation and video:

1. At the period from 00:21:59 to 00:22:41 there was a problem with the vote instruments; that was reported to the teacher, see Figure 4 below.
2. At the period from 00:30:56 to 00:31:38 the teacher was teaching about assessment, see Figure 5 below.

3. At 00:55:36, one of the students could not get access to the printer, and asked for help from the teacher, see Figure 6 below.

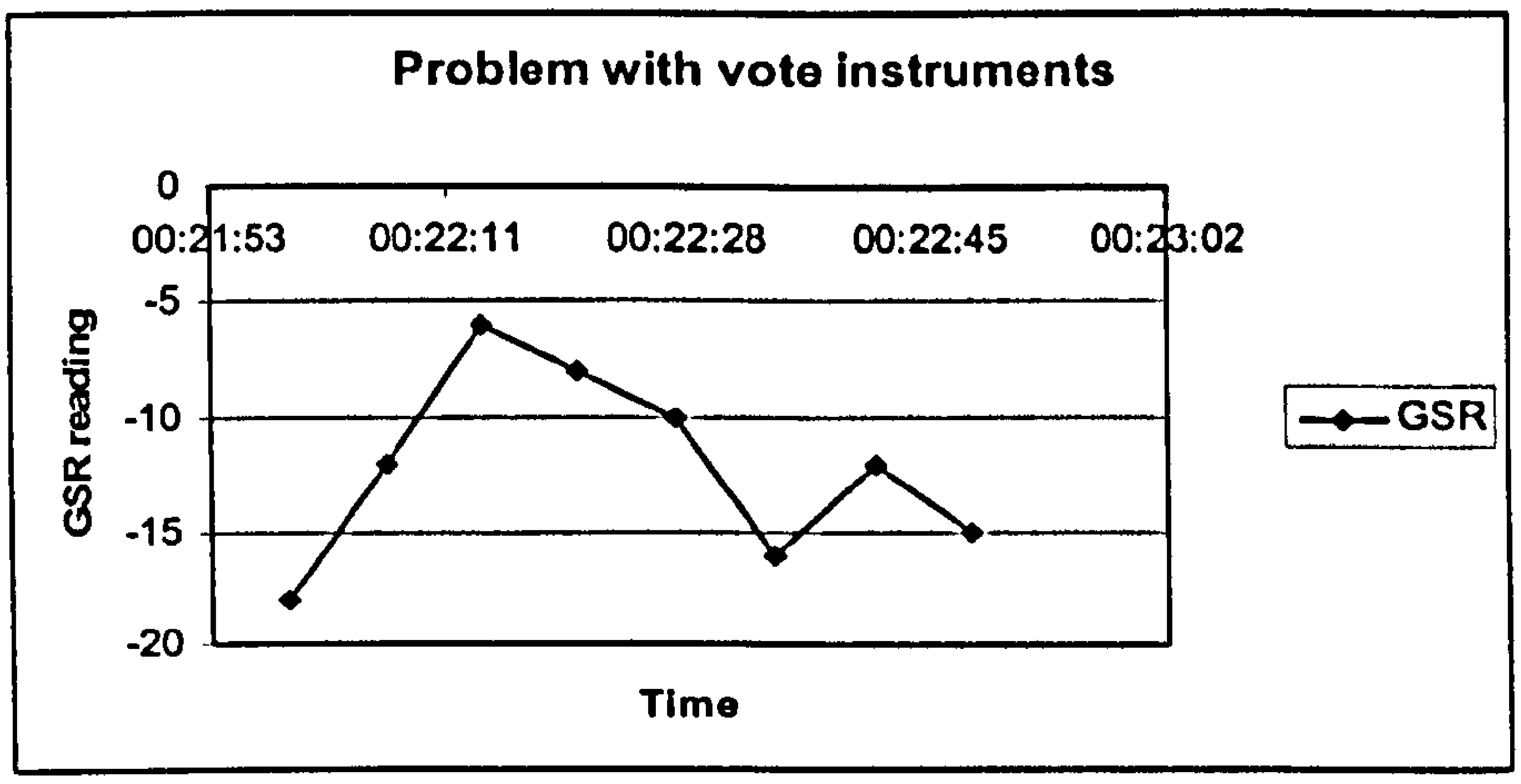


**Figure 4: The GSR readings for Teacher S when there were problems with the voting instruments**

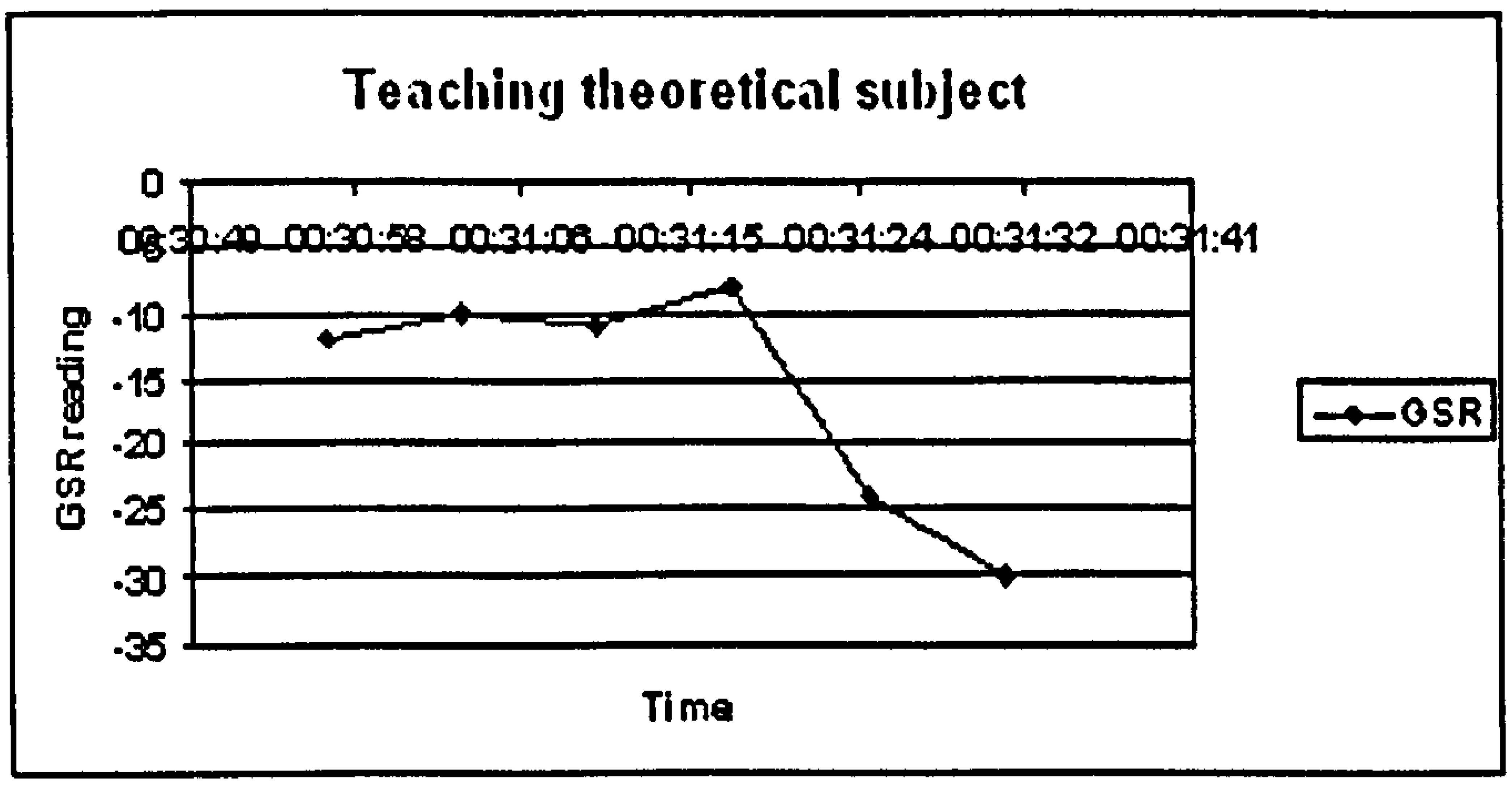


**Figure 5: The GSR readings for Teacher S when she was teaching about assessment**

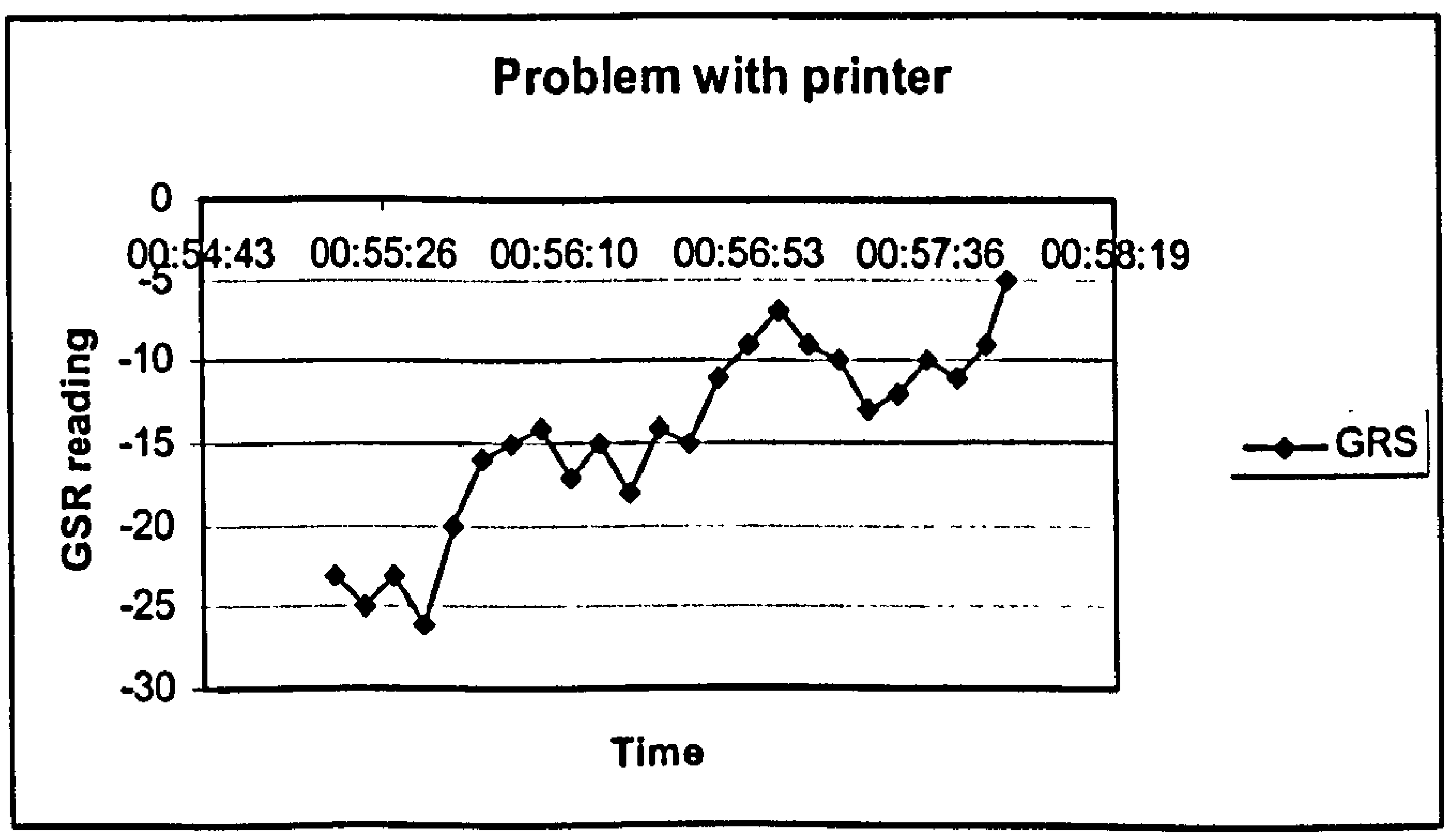


**Figure 6: The GSR readings for Teacher S when there was a problem with the printer**

Figures 4 and 6 show the changes in the GSR reading due to problems with the technology. Figure 5 shows the changes in the GSR reading while teaching assessment. These problems of technology in Figures 4 and 6 were observed and reported by the teacher when she was asked. Teacher S said that during all these three times, she had experienced stress.

On a number of occasions when the researcher asked the teacher about an event where there was a change in the readings of the GSR, she confirmed that she had experienced stress because of that event. As it has been seen in Figure 4 the GSR reading for teacher S increased from -18m to -6m at 09:35 am, and when asked about this she stated that at this time she had a problem with the voting instruments. On another occasions, she was not sure of the reason for the increase in the GSR during her session (e.g., red colours above). In this section of 13 minutes, there were four episodes of possible stress indicated by the GSR reading. It was possible for the teacher and the researcher to identify the stress on two of these occasions but not on the other two. Whether this is caused by failure on the teacher's part to recall the stress or by the GSR reading rising for some other reason other than stress, it is not possible to determine. Sometimes teachers complained about stress and yet there were no big changes in the GSR readings (e.g., at the time she was preparing for the session).

### Remarks on the Use of the GSR

Some problems with the operation of this instrument were experienced during the study:

1. Sometimes when a teacher left the classroom and went more than 20 metres away, the GSR did not receive any signal. The manufacturer (Brainquiry) claims a range of 100 metres, but this range may apply in an open area rather than indoors.
2. This study found variation in baseline figures (e.g. morning session and afternoon session). This could be because of the changes in the temperature of the classroom, similar findings were also reported by other studies (see, for example, 'Skin Conductance inconsistencies' factors', Idzikowski and Baddeley, 1983; Ward and Marsden, 2003).

### *7.2.2. Interview*

The way of conducting the interview was explained in Chapter 5 (see section 5.6.3). The example below describes the interview with teacher S; the purpose is to give the reader an idea of the interviews conducted in the study.

*Q- Have you experienced any kind of stress during the class?*

A- "Er ... yes, definitely, erm ... especially at the beginning. ... erm ... when the active votes didn't work, the first things I asked them to do ... erm ... was vote with the voting devices and that didn't work and that was ... erm ... (that, that) I got stressed at that ... erm ... I felt stressed because the topic that I was talking to them about, me personally, I don't like it ... [laughter] ... I think it's a hard part of our job and it's not easy ... it's difficult"

"... erm ... when they ... when the students I'm having today – when they use it - that doesn't make me stressed when they're using it because ... erm ... most of them are quite ICT confident and I can normally say just go to 'My Computer' or just go to ... erm ... the 'Home Directory' or go to 'My Documents' and it's in there and I know that they will be able to find it, so if they can't find it because they are not sure how to navigate around I know that I can come and quickly tell them. So that doesn't stress me"

*Q- One of the students called you asking for help. What was the problem?*

A- "Printer? ... yes ... that was stressful because I didn't know ... erm ... that we couldn't print. What has happened is the way we print has changed in this building and nobody told me that, what maybe nobody told me, I wasn't aware that from logging on how they have logged on, they couldn't print ... so that needs to be changed."

*Q- How did you cope with this problem?*

A- "Yeah, ... with the printing I know that I can work around it because if I log on as somebody else ... the first thing is always to try and think of an alternative way that it can be done like the printing so that if I logged on as somebody else and they put it in the shared area, if they really needed to print it out they could now come and print from that computer. So in the first thing it's kind of irritating and annoying and that's probably when my stress level goes up but then I would try and think of how we could work around it and I think I can do that because I know the system here"

*Q- One of the students asked you about an error in his computer I saw you using the phone to call ... ?*

A- "Yeah, I was going to telephone the technicians to tell them about the printing ... but then I forgot, I got diverted didn't I, I didn't do it – I went off and did something else ... yeah ..."

*Q- Sometimes students ask about something in the software you may not have that much of information about it. How do you feel in this situation?*

A- "Sometimes ... erm ... sometimes I don't mind, with this group - I would say I don't know but I would go and find out. If I am teaching a lesson where somebody [is] watching me and they are expecting that I know everything ... then yeah, if it's not working or if I don't know what I'm doing, ... yeah, that's very stressful."

*Q- Sometimes students ignore teachers and play with technology. Some teachers think that they might lose control of the class. What about you?*

A- "[Laughter] ... yes, ... yeah ... what in that I make them come away from the computers and sit in front of the board ... and that is where in part because I teach primary children, I can do that, if I taught secondary pupils I wouldn't. If I taught secondary pupils I would learn how to lock their screens from my computer so that whatever they did, they couldn't do anything."

"Erm ... oh yeah , yeah ... that (that that ) ... I won't ... yeah, ... erm ... I won't ... that's not acceptable to me that they are like that so I will say stop and [you know] come and sit in front of the carpet and then I will tell you the next thing but with these students I don't think it's a problem ... maybe you've been watching them more ... I don't know [laughter] on the video evidence ... erm ... [yeah] with this group I don't feel that they are carrying on working when I am trying to tell them something."

*Q- Do you like teaching with technology?*

A- "Yes ... yes, I do but I think I have come to understand and know and accept that it doesn't always work and I think you have to know that - if you expect it to be perfect all of the time then ... erm ... you will be very, very stressed – you have to know that sometimes for no particular reason - it doesn't work"

*Q- Are you aware of technostress? Can you differentiate between other factors of stress and technology-related stress?*

"I don't think I am because I think as a teacher it's quite a stressful job and I think all my stresses go together in one group and I don't identify that as a 'technostress' or that as a 'teaching stress' or that as a ' I've-got-too-much-to-do stress' – I think for me that maybe they come all together. Does that make sense?"

*Q- Can you please explain exactly what do you feel when you experience stress in the classroom due to technology?*

A- " ... erm ... well yes, I mean that active vote thing I don't know why that doesn't work, last week it was working, today it doesn't work – I have no idea why so that was really like, but maybe it's more frustrating than stressful - it's both - frustrating and stressful – because it's frustrating and then a little bit of stress comes with that because your thinking – you know - 'It's not working – I can't do what I planned' – does that make sense?"

*Q- Please, explain how you cope with stress in the classroom due to technology?*

A- "[Laughter ] ... oh ... sometimes I shout ... [laughter] ... I get ... I don't know ... I think I just ... we try and solve the problems that are causing us stress so like with the printing today at some point I will go and see the Technical Team and say 'My students can't print, please can you fix that' ... so I can go to other people and they can help me fix the problems that are causing me stress."

*Q- Experiencing stress everyday is not good for your health ...?*

A- "No, ... no ... erm ... I exercise ... I play sport quite a lot ... erm ... sometimes I just, when I go home I just need to do nothing. I think when the day has been really busy and really stressed, I actually find managing that stress quite tiring and so I do get quite tired and so I will just go and chill out at home or ... yeah, sleep ... I sleep a lot ... [laughter]."

## 7.3. Analysis

The survey in the previous chapter provided some evidence of how participants see technostress in the classrooms. In the survey, the researcher gave prompts related to both causes and symptoms, yet some went beyond the researcher's prompts and in response to the open-ended questions, they provided additional accounts of their experiences including indentifying time wasting as a cause and frustration as a symptom. In order to gain a deeper understanding of technostress, a number of observations of teachers using technology in the classroom were carried out.

In this approach, the data was collected as follows: (a) the observation notes about each teacher were gathered, the videotapes and the GSR readings were reviewed again and some other notes were written about each event in the classrooms for each teacher – which had been missed at the observation, and (b) the interviews were transcribed and prepared for coding. Some of the notes from the two methods (observation and interview) were not used, as they were not relevant to the study; for example, it was decided not to include discussions of teachers' salary, or teachers' relationship with their colleagues. The notes from the observation and the transcriptions of the interviews with nine teachers were analysed using the NVivo program.

The method used to analysis the data of the open-ended questions in the survey had been very productive, so it was decided to adopt a similar approach to the analysis of this data. The NVivo program was used just to organise the data. Simply, in a descriptive way, the researcher wanted to know what were the causes, the symptoms, and the coping strategies, and any other factors that might be used to support the argument. The method that was used did not allow the researcher to look at the dimension of time, and that was why the researcher also used the case study method in order to get a description of a teacher teaching a particular class with an account of the general characteristics of the teacher intertwined with an account of their work in a session.

The coding was in the same way as for the analysis of the open-ended survey questions (explained in section 6.5.1). Figure 7 shows a short text in which an example of how passages were coded at different child nodes.

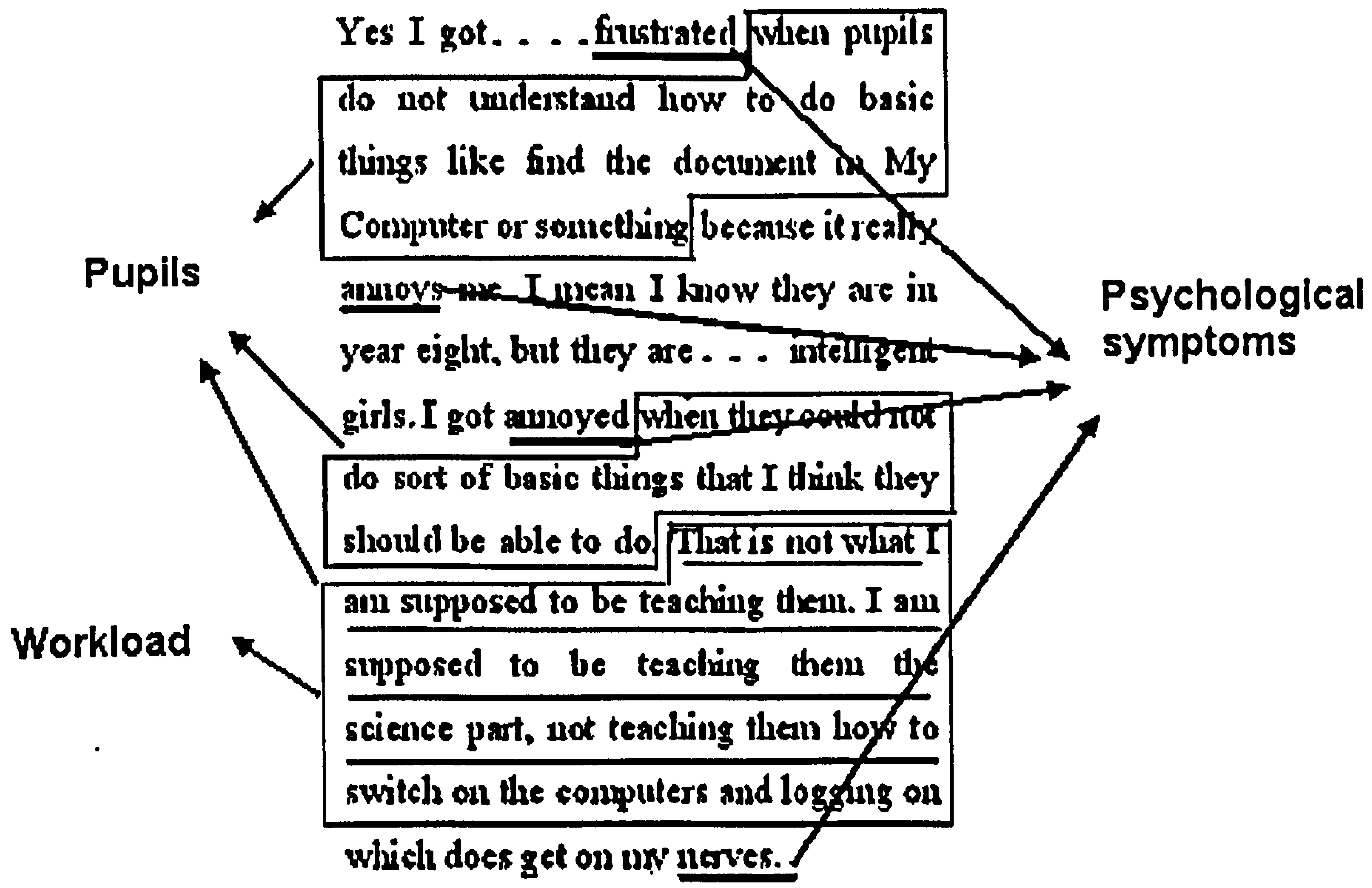


**Figure 7: Sample of passages coded at three child nodes**

The nodes used in the analysis were in part generated from the literature review, the T-TE model, and the research questions. They represented the main concepts of the study namely: causes, complexity; symptoms; and coping strategies. Parent nodes and child nodes of complexity, symptoms, and coping were derived from the literature. For the causes node, the procedures used in the open-ended data (6.5) were used for the data from the classroom investigation. Whilst in the surveys teachers were asked about moments of stress, it was possible in the classroom study to observe moments when stress did not exist. These incidents were therefore coded as 'No technostress'. Child nodes of this category were derived by an examination of the data. The top level nodes were:

- **Causes Node**: all units referring to factors that were associated with technostress whether related to the environment or to teachers

- **Complexity Node:** all units that were being associated with the types of complexity namely: unpredictability, workload, or simultaneity (these were additional coding for units, which had already been coded as 'causes').
- **Symptoms Node**: all units referring to symptoms of technostress were coded at this node.
- **Coping Node**: all units demonstrating ways used to cope with technostress were coded at this node.
- **No Technostress Node**: All the sections of text that related to the use of the technology in the classroom AND where the teacher was clearly not stressed were coded at one four child nodes of this node (e.g., occasions were teachers were pleased and satisfied about the use of the technology, and reported that technology helped them to deliver the subject).

The data also contains other issues and factors reported by the participants such as: teacher's salary, and phobia. These factors were coded to a node labelled as 'Other Node', and played no further role in this analysis.

### *7.3.1. The Nodes*

From the interview and the observation, 22 nodes were identified that include 5 main nodes: causes; complexity; symptoms; copings, and no technostress, along with 17 child nodes, as shown in Figure 8.

| Tree Nodes | | |
|---|---|---|
| Name | Sources | References |
| causes | 9 | 85 |
| technological problems | 7 | 42 |
| time wasting | 6 | 17 |
| lack of support | 4 | 10 |
| pupils | 5 | 16 |
| teachers | 8 | 23 |
| complexity | 0 | 0 |
| unpredictability | 6 | 27 |
| workload | 7 | 18 |
| simultaneity | 4 | 6 |
| symptoms | 0 | 0 |
| physical symptoms | 5 | 11 |
| psychological symptoms | 7 | 19 |
| behavioral symptoms | 4 | 6 |
| coping | 0 | 0 |
| problem-focused strategies | 9 | 33 |
| emotion-focused strategies | 5 | 11 |
| no technostress | 0 | 0 |
| technical support | 5 | 7 |
| social support | 6 | 16 |
| performance of technology | 6 | 27 |
| training | 6 | 12 |

**Figure 8: Classroom investigation (tree nodes)**

### *7.3.2. Causes*

All the units that were associated with the causes of technostress were coded at one or other child of the Causes node. The five child nodes can all be thought of in terms of lack of fit between the teacher and the technological classroom; namely, technology problems, time wasting, lack of support, pupils' misuse of technology in the classroom, and teachers' lack of training, negative attitude, etc as illustrated in Table 59.

| Causes (5 child nodes, 108 units) | Lack of fit (Demand-Ability & Supply-Need forms) | Environment factors (TE) | Teacher factors (T) |
|---|---|---|---|
| **Technological problems** (42 units) | D-A form | Errors to be fixed | Inability to fix errors |
| **Time wasting** (17 units) | D-A form | Preparing, installing technology | Inability to control |
| **Lack of support** (10 units) | S-N form | No or delayed technical support | Need for technical support |
| **Pupils** (16 units) | D-A form | Explaining the use of technology to pupils, or fixing errors caused by pupils | Inability to deal with the problems related to student's use of technology |
| **Teachers** (23 units) | D-A form | Technology skill required | Lack of required technology skill |

**Table 59: Causes node (classroom investigation)**

Table 59 shows the child nodes of the lack of fit between the environment and teachers that led to stress. These child nodes consist of 'technological problems', 'time wasting', 'lack of support', 'pupil' and 'teachers '.

### Technological problems

42 units were coded at this node. The technology was not satisfying and obstructing teaching because it was uncontrollable by teachers, thus the misfit between T and TE causes stress. Examples:

"With the whiteboard not working was the first kick off and then they not being able to open the software in a way that I had so rejoiced about earlier. That'll teach me not to be too happy about it".

"I expected to have a problem so I checked it and it worked and when they [pupils] came to do it, it didn't work. And they couldn't hear any sound from the web-site".

"I would advise anyone never ever to put ... his wireless network because they are nightmare".

Some participating teachers raised negative features and poor performance of the software, examples:

"I had to do the narration and the software does not stop or at least it does stop but it stops a pause at the wrong point so when you demonstrating the software, so that would be much better if it pause to the end of each section".

"There was a lot of introduction and that wastes your time and detracts you from what is important so we did not need to be told we are going to see this and this and this".

"There were no summary [in the program] at the end students have to do their own summary it would be good to have summaries were you had the four test tubes labelled with what you had added and what colour change so when they start doing the test they would have that summary on the screen".

"Students were unable to go back if they went forward too early or needed information from a previous page".

"Students often didn't know where they were because the tasks weren't numbered, they found it very difficult to skim-read the text on screen and they often missed the top of page instructions completely because their eyes were drawn straight to the centre of the screen - the work would have been more accessible if the instructions appeared in a large box - centre screen - that they had to minimise to get at the web content - or used some other trick to make them stand out".

One teacher commented on the fact that software was not able to adapt to the pupils characteristics in the same way as a teacher could: "boys do not want to be given advice, unless they have asked for it whereas girls want, girls appreciate advice but on the other hand, if you programmed your computer mentor to say, look this is a boy you are dealing with; do not give him any advice until he asks for it; this is a girl ... just suggest thing she could do that she might want to do, but even so you have run against people who are boys, different boys nothing wrong with them but they have a more female way of working, and teacher could cope with that".

Designers sometimes focus on certain features and ignore others such as being editable. But teachers may have other opinions as one recommended that "... when we build a software ... is to be built-in flexibility either by making the things editable or if things can't be editable because they are in a special play software to build in choice". Moreover, designing software is a complicated task, and what is happening in the classroom is completely different from what is in the software. Those who design software may not be teachers. Teachers as users should be involved in designing because they know more than 'those who are not working in the classrooms', as stated by one teacher. Also in a long explanation, one teacher reported that "a database of educational software is kept at the moment - companies pay to have their software reviewed by Evaluate or Schoolzone before it is added to the database - because the company pays, the reviews have to be balanced and constructive. They are done on a freelance basis by practicing teachers. I'd like to see the process include a usability report that goes to both the company and an external coordinator. They would become an expert in what works and what doesn't and would make periodic recommendations to the major software developers".

**Time wasting**

17 units were coded at this node. Some teachers in some situations thought that technology might waste the time when preparing, or/and explaining technology, for example: "I have used these laptops about three times in a year and the last time was about in September was the last time I took these things out because that was the last time they did not work so I thought am not doing them anymore to waste the time ... so I haven't used it since then because I just thought I am not wasting a lesson on these stupid computers so the girls upstairs use them a lot ... and ... but I don't use them very much".

**Lack of support**

10 units were coded at this node. For example, one teacher stated "some teachers do not want to use technology and if you give them like this kind of technology? I am not surprised because a lot of technology isn't intuitive is difficult to install I got this ... software which I said it is so good I have had two years it is not on the network all that time I have not been able to use it because I have to wait for an IT technician to install it, you have really want to use software to push for it to be installed in the network".

**Pupils**

16 units were coded at this node. This related to the misuse of technology by pupils or ignoring of teachers by pupils while they use technology in the classroom. Examples:

"... any work or save any work that tend to happened is that there are more able students don't have to face any of these problems because the more able students have got USB key of their own, and so they just are freed from any difficulties because they save their work on their USB key or they e-mail it home, the less able students have got no idea I mean you saw in this lesson they did not know how to get off".

"Yes, I got quite frustrated when pupils do not understand how to do basic things like find the document in 'My Computer' or something because it really annoys me. I got annoyed when they could not do sort of basic things that I think they should be able to do. That is not what I am supposed to be teaching them. I am supposed to be teaching them the science part, not teaching them how to switch on the computers and logging on which does get on my nerves". This example was not related directly to technology but caused by specific pedagogic relationship, which happens to involve the use of technology.

"Students accounts a generally poorly managed and the NC for IT does not focus enough on basic housekeeping and keyboard skills that could transform the learning of the least able pupils across the curriculum". Another example was observed in different sessions and was about students who, as they sit in front of the screens, start to play with the technology and sometimes ignore their teachers. It was noticed also that while the teacher was helping one student, some other students started to misbehave, and this might lead the teacher to get stressed.

**Teachers**

23 units were coded at this node. This relates to teachers' lack of training, ability, and skills, which are needed in order to enable the teacher to deal with the demands of the technology. Examples:

"When I have got ... a year nine and there was probably nearly 23 of them and each have a laptop and the thing is I have to go from one child, Miss, Miss, Miss, help me help. So I helped them. Miss, Miss, help me. So there was no break at all and it was constantly moving. And then when I get to the end I have got to start again because the first girl put her hands up again and then they go to Miss you look really stressed and you look really... I said 'well I am not angry it's just is very tiring to go round and do every ones work'".

"What makes it such a stressful job I think is that it's the performance aspect, not in terms of delivering it but in terms of performing and managing everything through time and how quickly things happen and whether they are successful or not, and that's why teachers get tired. Work long hours to make sure they are prepared. When you are new in the classroom and you see somebody who is in the sort of consultancy or training role if I look back at it, I used to think, well how do you, you know ... how do you manage that, how do you learn enough to be able to do that and I think the key thing is that ... maintaining the lesson. Even though everything is falling down around your ears. And so that's the sort of level of professionalism you have to be at isn't it?"

Some of these examples perhaps illustrate the lack of preparedness on the part of the teacher for teaching with technology.

Another example that has been observed in different sessions with different teachers was 'hurrying'. Hurrying might provide a reason why some teachers experience difficulty while using technology. Some teachers deal with the software or hardware in front of students in a faster way than when they are working alone at usual pace. They want to get everything completed as fast as they can. Therefore, they get different problems. While in their free time, few of these problems might occur because they deal with technology in a calm manner and give time for the technology to respond. Hurry and less concentration in dealing with technology in front of others might cause some errors and, therefore, cause stress to teachers. An example was noticed when teacher K who checked the musical software before the class and at home but could not open it again for the students.

Data in this section reflects what were found in sections 6.2.2 and 6.5.1 where the evidence related to causes were considered, and will be taken together with this data in order to provide a fuller discussion of the place of causes of technostress in section 8.3. The causes observed and reported in this section clarify the picture found in the survey. Causes such as errors were listed in the closed questions and were reported in the open-ended responses, but in this section, specific errors are noted, such as in the use of the voting instruments, or IWB.

### *7.3.3. Complexity*

Earlier, it was argued that many causes of stress associated with technology could be related to aspects of job complexity; in this section, it is shown that about half of the data coded as causes could also be coded as forms of complexity (i.e., workload, unpredictability, or simultaneity). This data reflects what was found in section 6.5.2 and will be discussed in terms of the literature in section 8.4.

All units coded as 'complexity' were also coded as 'causes', but not all units coded as 'causes' were also coded at the complexity node. For example, Figure 7 above shows that one of the causes was related to the pupils (where the teacher stated that she is supposed to teach the pupils science not how to use the technology); this additional work was added to the teacher – teaching less skilled students how to use technology – and this could be related to 'workload' complexity type. On the other hand, one of the causes was related to teacher's need (where the teacher was not able to use a piece of software because it has not been loaded by the technician on the school network); this kind of cause could not be related to any of the types of complexity. The complexity factor consists of three main categories namely: unpredictability; workload; and simultaneity – see Table 60. All of these factors were derived from the literature as explained in Chapter 4.

| | |
|---|---|
| **Complexity** (3 child nodes, 59 units) | **Workload** (18 units) (6 teachers) |
| | **Unpredictability** ( 27 units) (5 teachers) |
| | **Simultaneity** (6 units) (4 teachers) |

**Table 60: Complexity (classroom investigation)**

**Workload**

18 units for 6 teachers were coded at this node. Activities such as preparing the technology for the students or helping students open and/or save their work increase teachers' workload.

"As the rate of change within technology accelerates, teachers are increasingly being expected to become adept with its use. This means shedding earlier knowledge and ways of working and adapting to new and ever changing ways".

"Work long hours to make sure they are prepared".

**Unpredictability**

27 units for 5 teachers were coded at this node. Different, unexpected errors and faults were noticed and reported by the participants, and these were difficult to control. Examples include:

"… when technology does something teachers are not expecting or opens a window that they have not seen before. This can cause panic because they assume that; they've done something wrong, that; it's irreparable and; they don't know how to get back again".

"It's not about our knowledge about technology that makes it work, because even though you think you've set it up to work it then does something that you're not expecting".

There was an error in the network and as a result none of the students could get access to the network. So the teacher asked them to do other work and said to the researcher: "With technology you could expect anything to happen … and without the … network we could not do anything".

**Simultaneity**

6 units for 4 teachers were coded at this node. Examples include:

"The main hold-ups were dealing with the instability of the wireless network and a design factor in the software that prevented students who had rushed ahead from backtracking - which meant there was little time to interact with pupils and draw out ideas".

"When I have got … a year nine and there was probably nearly 23 of them and each have a laptop and the thing is I have to go from one child, Miss, Miss, Miss, help me, help. So, I helped them. Miss Miss, help me. So there was no break at all and it was constantly moving. And then when I get to the end I have got to start again because the first girl put her hands up again and then they go to Miss, you look really stressed and you look really… I said 'well I am not angry it's just is very tiring to go round and do every ones work'". Also one teacher stated, "I have got to do five things in the time it takes for one minute".

Of the 108 units coded at one of the child nodes of 'causes', just 51 were also coded at child nodes of 'complexity'. Table 61 below shows the distribution of these units. 25 units coded as 'technological problems' such as errors were also coded as the 'unpredictability' type of complexity. 13 units coded as 'technological problems' such as fixing network problems were also coded as the 'workload' type of complexity. Two units coded as 'technological problems' such as doing the narration of the software and writing notes on the board were also coded as the 'simultaneity' type of complexity. Two units coded as 'time wasting' for example preparing technology added load to teachers and so were coded as the 'workload' type of complexity. Two units coded as 'pupils' for example, errors due to pupils' misuse of technology were coded as the 'unpredictability' type of complexity. Three units coded as 'pupils' – i.e. teaching students how to use technology – were also coded as the 'workload' type of complexity. Also four units coded as 'pupils' – i.e. helping and monitoring less skilled pupils - were also coded as the 'simultaneity' type of complexity. Units coded as one of the forms of complexity had mainly been coded as 'technological problems', and almost all nodes coded as 'technological problems' had also been coded at one of the child nodes of complexity. So these two concepts clearly overlapped quite significantly. About half the units coded at the pupils node were also coded at one of the child nodes of complexity – though this only accounted for about an eighth of the units coded at one of the child nodes of complexity.

| | Complexity | | | Other |
|---|---|---|---|---|
| | Unpredictability | Workload | Simultaneity | |
| **Causes**<br>(5 child nodes, 108 units) | **27 units** | **18 units** | **6 units** | **57 units** |
| **Technological problems** (42 units) | 25 | 13 | 2 | 2 |
| **Time wasting** (17 units) | | 2 | | 15 |
| **Lack of support** (10 units) | | | | 10 |
| **Pupils** (16 units) | 2 | 3 | 4 | 7 |
| **Teachers** (23 units) | | | | 23 |

**Table 61: Complexity and causes (classroom investigation)**

### *7.3.4. Symptoms*

The 'symptoms node' includes three child nodes namely: (a) physical symptoms, (b) psychological symptoms, and (c) behavioural symptoms, which were reported by teachers when they use technology in the classroom, as illustrated in the Table 62 below.

| | |
|---|---|
| Symptoms (4 child nodes, 37 units) | **Physical symptoms** (11 units) (5 teachers) |
| | **Psychological symptoms** (19 units) (6 teachers) |
| | **Behavioral symptoms** (6 units) (4 teachers) |

**Table 62: Symptoms (classroom investigation)**

Examples of psychological symptoms were feelings such as frustration (5 teachers), annoyance, and anxiety. One teacher reported "When anything goes wrong it is just my worst fear is what am I going to do with thirty children. They are going to go mad". Teacher K was very angry and frustrated after teaching one session and stated "It's not a good day for technology today...we should have looked at the stars. Unbelievable! I said that there were going to be stresses in this session because it was less of a routine session for me but, goodness me, I wasn't expecting half of those things to go wrong. And then you are trying to absorb all the stresses of the teachers because you know they are going to say oh you know that happens at school and it's the one reason why they don't want to use technology. And now you're trying to say it's not stressful at all". The physical symptoms were things such as 'headache', 'sweaty' and 'got hot'. One teacher explained her feelings by reporting that "Oh ... I have to sort of change my breathing ... it's a sort of ... and I've got to get it done quite quickly so it looks seamless so that the children and their learning don't experience an interruption". Six units were coded as showing behavioural symptoms, for example 'shouting to students' or 'drinking a lot of water' during teaching.

Data in this section reflects what were found in sections 6.2.3 and 6.5.3 where we considered the evidence related to symptoms, and will be taken together with this data in order to provide a fuller discussion of the place of symptoms of technostress in section 8.5.

### *7.3.5. Coping*

The coping node included two child nodes; (a) problem-focused, and (b) emotion-focused. As explained previously, the problem-focused strategy is an attempt to change the features of the environment, especially those that cause stress to individuals, whereas the emotion-focused strategy is an attempt to deal with the emotional disturbance resulting from demands (see section 2.4.3).

| | |
|---|---|
| Coping (2 child nodes, 44 units) | Problem-focused coping (33 units) (7 teachers) |
| | Emotion-focused coping (11 units) (5 teachers) |

**Table 63: Coping (classroom investigation)**

In Table 63, 33 coping ways were categorised as problem-focused coping. For example, one teacher stated "I think I will try and plan ahead or when it is not working so I think enough to go to lessons with a sheet to use and you also saw me going on the whiteboard as well. But I mean that because I plan in case things aren't working". Another teacher stated, "You can limit the amount of stress by having a number of pathways out of your problems and the more your pathways are limited out of the problem the more stressful it is for teachers". Table 63 shows other 11 units that were categorised as emotion-focused coping. Examples of this kind of strategy were things such as accepting and submitting: "I do not know. I do not do any sort of breathing exercise or any sort of calming thing. It is more rather than distressing myself. I try to make situations less stressful probably rather than doing anything". Another teacher thinks that relaxation is important for teachers and students. She stated "Had the teacher been their normal relaxed self the students would have been coaxed gently into good behaviour and the lesson would have continued in a much more positive way". One teacher reported that she convinces herself that she should not bother, and she stated "If I got worried about what technology made me look like and to be honest I don't mind how ridiculous the technology makes me look because it happens, and it doesn't make me any less professional or any less good at teaching".

Data in this section reflects what were found in section 6.5.4 where we considered the evidence related to coping, and will be taken together with this data in order to provide a fuller discussion of the place of coping with technostress in section 8.6. This section shows some of the technostress related coping strategies: relaxation, avoiding the use of technology unless they had both the need and the capability.

### *7.3.6. No Technostress*

In a number of situations, teachers reported no signs of stress whilst working in a technological environment. Some examples could be thought about in terms of the Need-Supply form of fit: Teachers' needs in the technological environment were fulfilled with a satisfactory supply in terms of technical and/or social support, and reliable performance of the technology. Other examples could be thought of in terms of Demand-Ability form of fit: Teachers' abilities due to training and practise were adequate to the demands of the technological environment. Table 64 shows the No Technostress node, which included four child nodes. Examples:

**Technical support:**

"I think stress is reduced if you've got another professional working with you and I think that goes for if you've got difficult pupils in the classroom and you've got an experienced support assistant ... if you've got another adult who shares the problem solving with you".

**Social support:**

" ... and I had been doing this together as a workshop we would both probably have experienced the same stress levels but we both would know that we could rely upon the other to help resolve the problem. It makes us feel a bit more safer".

**Performance of the technology:**

"This was not a very stressful lesson, was it? ... Yes, if it was Friday afternoon with class year eleven I think you will probably go up your scale haah, because this to me I felt like a holiday lesson because the computer was doing all the work I felt that I was not doing anything".

**Training:**

"I know that they will be able to find it, so if they can't find it because they are not sure how to navigate around I know that I can come and quickly tell them. So that doesn't stress me".

<table>
<tr><td rowspan="3">No Technostress node (4 child nodes, 62 units)</td><td>Support:<ul><li>Technical support (7 units)</li><li>Social support (16 units)</li></ul></td></tr>
<tr><td>Performance of the technology (27 units)</td></tr>
<tr><td>Training (12 units)</td></tr>
</table>

**Table 64: No Technostress node (classroom investigation)**

### *7.3.7. Discussion*

The previous sections about causes, symptoms, and coping strategies were similar to those reported in the survey, but the examples in the previous sections enable the researcher to get a clearer view of what these categories mean in practice. For example whilst a teacher in the survey might say that he/she experienced technostress due to 'errors', 'when things do not work', etc. in general concepts, it was possible sometimes to obtain much more detailed accounts from the teachers in the classroom investigation; for example, they reported some limitations of some software (such as long introduction, bad performance, etc.) or errors (such as vote instruments). Looking at pupils' misuse of technology as a factor, it was reported by only two teachers in the survey, but was reported by five teachers in the classroom investigation. In the survey, it was rare to find participants who reported positive points about technology (it could be due to the method itself and the questions designed, but they were giving some rooms to express their views), and it was possible to sense that the majority were complaining (see section 6.5.1); in the classroom investigation, however, teachers provided some positive experience about technology (see No Technostress, 7.3.6, above). This led to gain two important points the first was that there was a need to try different approaches to investigate phenomenon of technostress and should not relay on one approach, also more information was gained about technostress when we used the second approach. Moreover, complexity was discussed in chapter four and different authors (such as Doyle, 1990b) argue that to claim about complexity in the classrooms, researchers were better advised to go to classroom, observe, interview, video, etc. to gain more data to support their claim. Doing this gave more detail about complexity and types of complexity in the classrooms that have been investigated. One more type of complexity was added in the previous sections from what have been found in the survey, indicating that they – authors - were correct about their argument.

The use of NVivo above enabled the researcher to get a better description of various categories, and in order to get a better account of what stress actually looks like in the classroom. The researcher used the concepts derived from the literature and refined by the data collection and analysis to analyse the behaviour of specific teachers dealing with specific issues in the classroom, and then constructed a number of case studies. The following sections will describe four case studies.

## *7.4. Case Studies*

This section will present four case studies of four teachers teaching a particular class with an account of the general characteristics of the teachers intertwined with an account of their work in a session, this were derived from the interviews and the observations. Each case will consider some important points such as: teacher's characteristics (age, gender, kind of school), teacher's attitude towards technology, general description about their use of technology in the classroom, some information about their use of technology, and the causes, the symptoms and the coping strategies they used. With regard to stress, the researcher will ask to what degree can this teacher be described as experiencing technostress; with regard to causes, the researcher will ask to what extent can these causes be interpreted as a misfit between T and TE?.

Four teachers, one within each of the following categories, were selected:

- Teacher of age 35 or under, with a positive attitude to technology, and uses technology a lot – teacher S.
- Teacher of age 36 or more, with a positive attitude to technology, and uses technology a lot – teacher P.
- Teacher of age 35 or under, with a negative attitude to technology, and does not use technology a lot – teacher ST.
- Teacher of age 36 or more, with a negative attitude to technology, and does not use technology a lot – teacher R.

These case studies will be used mainly to examine the nature of the relationship between the teachers' use of technology in their classroom and technostress, and hence determine the adequacy of the T-TE model used in this study.

### *7.4.1. Case Study of Teacher S*

Teacher S is a female teacher age between 30 and 35 years old, teaching in a Community Learning Centre (CLC) in London. She teaches teachers to use technology in the classroom. Some of her classes are about the various kinds of learning software. She likes to teach with technology and has positive and extensive experience of teaching students and teachers in how to use technology as well as its use to teach another subject.

The researcher attended a session where she was teaching ICT to a group of ICT coordinators. The subject she taught was the ICT curriculum and assessment. In this class, she explained about some educational software used in the CLC she taught in, and discussed issues about assessment, ICT capability, and pupils, and the difficulty they face when they use technology. Then she asked the students to try for themselves some educational software on the CLC website. She experienced some problems with the technology while she was teaching and some other problems with students in the classroom, as some were not interested in what she was saying and therefore ignored the teacher. Nevertheless, she looked very confident, with good skills when she used technology, and whatever problem arose, she tried to solve it. She seemed to be familiar with technological problems and dealt with them as if they were a normal part of the class. When technical problems occurred, she tried to solve them, and if she was not successful, then she would ask technicians to solve the problem. In this session, teacher S experienced technostress three times; one time when there was a problem with the vote instruments, the second when there was a problem with the printer, and the third when she taught about assessment. The first two events happened accidentally, and she was not able to solve these errors. The third was because she had to teach about assessment, which was a theoretical subject in which she had to read some instructions for her students, and she said that she was uncomfortable with teaching theoretical subjects, that she preferred teaching practical lessons. Moreover, using technology to teach such a subject was boring - as she had to read some structures on the IWB, and then made some comments - and it caused stress as she had explained when the increase of the GSR readings was discussed at the time of this event. She expects problems with technology to occur from time to time; "I think I have come to understand and know and accept that it doesn't always work and I think you have to know that - if you expect it to be perfect all of the time then ... erm ... you will be very, very stressed – you have to know that sometimes for no particular reason - it doesn't work", and so these events perhaps do not cause her a lot of stress. In the interview, she told the researcher that the vote instrument was working in an earlier session the previous week, so she did not experience stress last week.

She views technostress differently from the other teachers interviewed. For her, it is not only the technical aspects that can cause stress but the social nature of the task as failure is something that is immediately shared with others such as pupils "If I am teaching a lesson where somebody is watching me and they are expecting that I know everything ... then yeah, if it's not working or if I don't know what I'm doing ... yeah, that's very stressful". She considers the assessment of others more important than the technological problems. She was not able to identify technostress. "I don't think I am [aware of technostress] because I think as a teacher it's quite a stressful job and I think all my stresses go together in one group". When she explains her experience of symptoms, she admits to having sometimes resorted to shouting and afterwards realised that this is a sign of stress getting to her. In the interview after the session, she said that she experienced technostress when technology did not work e.g., the vote instruments, and thus she did not know what to do in front of her students. This could be interpreted as a misfit between the supply of the technological environment (working vote instruments) and her need, and that caused her to be stressed. It can be seen that 'unpredictability' was a significant cause of stress for this teacher.

To cope with stress in this session she tried to fix the errors. When there was a problem with printer, she says she would "go to other people and they can help fix the problems that are causing stress".

Teachers S is a female teacher of age '35 or under', with a positive attitude to technology, likes to use technology, and uses it a lot. She knows how to use it effectively in the classroom as an ICT teacher. She accepts that sometimes technology causes problems but argues that it is possible to deal with it and therefore she does not experience a high level of technostress. Although the discussion above showed that this teacher experienced stress, yet in the interview (see section 7.2.3) when she described her experience of technostress, she said, "maybe it's more frustrating than stressful"; in this she signalled 'frustration' as a mild form of stress, so in her expression, technology is positioned as 'mildly stressful', rather than as seriously stressful.

### *7.4.2. Case Study of Teacher P*

Teacher P is a female teacher, over 45 years old. She teaches science in a secondary school in London. She is very active teacher, likes to use technology, and is confident and very serious. She is often asked to evaluate software – on a number of occasions the researcher saw researchers from companies asking her to evaluate software they were going to produce. She uses technology a lot.

The researcher observed a chemistry lesson that she taught in which she used the technology effectively despite minor problems. She seemed to use technology without relying too much on the technology. She used technology, but she also used the whiteboard to explain the subject, and she spoke quite a lot. She appeared to be highly proficiency and confident, to take the lead and drive the technology, not be driven by technology. At the beginning of the class, she asked the students to bring their laptops and switch them on, and not to use them until she told them to do so. She gave a small introduction about the subject; she linked it to the previous session, and then asked some questions. She warned the students about the safety aspects of what they were going to do, as they were about to use some chemicals to test kinds of food. She asked the students to pay attention to the explanation on the Interactive White Board (IWB), as she was going to play the software about the food test. While the software was running, she sometimes stopped it and explained the subject to the students, sometimes she wrote notes on the board. After the subject was explained on the IWB, she asked them to use the software on their laptops and to do what was shown on their screens. Some of the students had some problems with their laptops: some forgot their passwords; others were not sure how to open their folders - where they had to save their work. It took some time to solve these problems, and then they started to work and do the tests. After a few minutes, she asked the students to show her the results they got from their experiments, and wrote it down on the whiteboard, then explained to the students the reasons and corrected some mistakes they had made while they were doing their experiments. At the end of the lesson, she asked them to save what their files in their laptops. Some pupils could not save their work so she helped them to save it in her folder. Later, she asked them to return the laptops back to the place they took them from and to prepare to leave the class. On a few occasions, she was not able to use the software effectively; e.g., a number of abbreviations were mentioned in the introduction of the software, but later when they appeared on the screens she and her students were no longer able to recognise them and so needed to check the meaning in the introduction. She argued that there should be icons on the screen so that if she or the students needed to ask about something, then it should be there accessible by pointing with the mouse. This could be understood as a misfit occurred between teacher P and her technological environment; there was a misfit between what she needed from the software (ease of access to facilities) and the supply, or it could be interpreted as a misfit between the demands of the software and her ability to respond to those demands, which of these interpretations is adopted perhaps depends on to what extent one regards the demands of the software as appropriate within the context. In her classes, it was found that the majority of causes of technostress were unexpected, and were coded as the 'unpredictability' type of complexity. When teacher P could not deal with errors, problems related to less skilled pupils or with poorly performing software (see section 7.3.2), she experienced technostress. In this session, she was not happy about the demands made by her students such as saving their work. In this, although she experienced technostress, but she did not feel less confident in front of her students as she was able to solve their problems with technology and teach them how to deal with it, and this is probably the reason that the technostress she experienced in this session was not high.

She says that she experiences stress "when things do not work, and you are not sure why, and also it is the feeling that ... although I can do it myself, I am not ... enough to explain to somebody else how to do it without actually being with them." This teacher insists on the importance of using the technology many times before using it in classroom, this will reduce the number of problems that arise, as the teacher will become familiar with the technology, and this will decrease the probability of errors and difficulties occurring.

When teacher P faces any difficulty with technology, she feels frustration as a psychological symptom; for example, in this session she had a problem with an electronic pen. She is an experienced user with a positive attitude to technology, careful in her work with the students, and in using technology, but unexpected problems of technology crop up from time to time, and this makes her feel frustrated. Nevertheless, she would not submit to the problems and would struggle to solve them "I find it easier to use the mouse than this pen, and I kind to have to force myself to use this pen so whenever the pens involved I do not feel stress".

Teacher P is a female teacher of age 36 or more, with a positive attitude to technology, uses technology effectively, and uses it a lot. Her experience, strategies, and carefulness led her not to experience high level of technostress. Although she used the term frustration to express her feeling, yet she would always struggle to solve the problem i.e. using problem-focused strategies.

### *7.4.3. Case Study of Teacher ST*

ST is a male teacher. He is 33 years old and teaches science in a secondary school in London. He has a cheery personality, acts in a friendly manner to everyone including his students and the researcher thinks they have very good relationship with him.

In his class, he showed the students how to use Excel by playing a video, which was recorded by another teacher (female) who used to teach the same subject. The subject of the class was speed and velocity, where students were expected to do some calculations about speed, time, acceleration, and to construct tables and graphs using Excel. At the beginning of the lesson, it took some time for students to set up and prepare for the lesson. The teacher started by talking about the last homework they had and to give back their notes, then he talked about the subject he was about to teach and about the next class. They had learned in the lesson previous to this one how to calculate speed, so they were continuing in the current lesson to doing tables and graph with the help of Excel. After reviewing what they had done in the previous lesson, he told them that they would watch how to do these tables on the whiteboard. He ran the videotape. Actually, the recording was not good, the voice was not clear, and one can hear the sound of the keyboards when the teacher explained what to do, which made the students laugh. Teacher ST was listening, and then he wrote some notes on the board, the notes were a summary of what the teacher in the video said. Some students were writing and some others were discussing their work with each other. When the explanation finished, he stopped the tape and asked the students whether it was clear for them. He called some students by their names and asked them to show him what they have done. He was happy that some students did the work. Some of those who did not know how to do it asked him, and he told them to ask their colleagues. Doing this raised another problem between students; for example, in an occasion one of the students did not want other students to help her and wanted the teacher to help, when he refused, she was angry; on another occasion, one student refused to help her classmate. This sometimes would not allow the teacher to control the discipline of the classroom. Actually, some students made some noise while they were trying to help each other, and that took some time. At the end of the class, he reminded them about the subject for the following week and asked them to submit their work before they left the class.

It was sometimes hard for him to control the students' behaviour when they start to use their laptops. He has a negative attitude towards technology, and he does not use it a lot. "I haven't used it since then because I just thought I am not wasting a lesson on these stupid computers so the girls upstairs use them a lot ... and ... but I don't use them very much." In the science lesson, it was observed that his use of technology was reliant on the teaching of other teachers i.e. the software was explained in a video recording by another teacher, so he was using the software on his computer and the students were listening to the recorded lesson and following the steps explained on the video. The relation between teacher ST and his technological environment was not clear, as his abilities to deal with the technology could not be investigated, since he would to turn to some skilled students and ask for help to deal with the demands in his classroom. Many students asked for help as they were not able to follow what was explained in the video. Some students did not want to be assisted by their colleagues and continued asking help from the teacher, so there was a lot of pressure on him. The researcher does not know whether the strategy of asking other students was because of his inability to solve his student's demands or because he thought that such strategy might work better than his answering all the demands. In both cases, the inability to manage the increase of demands from the students could be described as a misfit between the teacher and his technological environment. He argued with some of his students. "I said, look, cannot explain that to you because there are other pupils waiting" and when asked about this in the interview, he admitted that it caused stress to him. The problems he experienced could be related to workload type of complexity. This workload was due to the demands put by his students regarding technology. In the interview, he stated that using software such as the PowerPoint might not cause him stress as he was trained how to use it, and he is capable of using it "I use PowerPoint I love PowerPoint for my lessons plans, and pictures I am ... getting better and better at using it, but before I come to the school, I was never never used IT, maybe kicked it out, so this is all new. This is all new for me".

He expressed his general feelings about technology in terms of anxiety rather than stress, saying, "It is reasonable to say I am anxious, anxious is just be a bit more alert, and a bit more trying, 'I have to get this done'".

The coping strategies he used to deal with technological problems were asking students to ask for help from one another. "So you have just a wait or ask your friends if they can do it, for example over here there was ... Indian girl and her friend two places away, she was black girl and ... was asking can you help me do this I want you to help me to do the graph ... They were beside each other, and it just effective for her to do it other than me to do it, but they had around me to negotiate and then ... came and helped, so that a situation to the problem, that kind of work, you just work it out when you stand there".

Teacher ST is a male teacher of age 35 or under, holds a negative attitude towards technology, does not use technology a lot although he is happy to use PowerPoint, and he said that IT is new to him. As he is not using technology effectively, he seems to experience anxiety due to technological problems. He stated during the interview that sometimes technology and demands of students cause stress, yet when he was asked about his general assessment of his experience of technostress he stated "It is reasonable to say I am anxious, anxious is just be a bit more alert, and a bit more trying, 'I have to get this done'". It is probably true that the teacher did not experience high technostress in this session, but there were few interactions with technology, and yet he experienced anxiety. Actually, evidence that this teacher experience high technostress could not found; rather than speculate the emotion-focused strategies he adapted as a sign of experiencing technostress, if he did not think that using technology would cause stress to him he would not use this strategy.

### *7.4.4. Case Study of Teacher R*

Teacher R is a female teacher of age 40 or more, teaching mathematics in a primary school in London. Teacher R seems to know about her subject, but finds some difficulties in presenting the subject she teaches, because she was asked to use software, which she was not fully confident about using.

The researcher attended a session where she was teaching her students how to add/subtract. At the beginning of the class she sat on a chair in front of the students, and asked them to sit on the floor. Her aim was first teach the students how to use the software on the IWB, and then they would go to their computers and try it themselves. She started by asking some questions and the students were answering, it was just as an introduction to the subject, and they behaved in very good manner. In addition, she was pleased about their answers. She turned on the IWB, and then started to explain to the students how to make the calculations. In many occasions when she tried to drag some of the shapes on the screen using the electronic pen, she start saying something like, "Let's see how to do it, am not so sure, but I think we should do..." sometimes if she faced problems like not being able to drag a line or a shape, she asked one of her students to do it, saying something like 'It might work with you'. After showing the students one example of calculation on the IWB, she asked them to go to their computers and try to do what she had just shown them. When they were using their computers, she was going around and checking their work; when they finished, she asked them to go back and sat on the floor and listen to the second example. Once, she had a problem with electronic pen; she could not drag it on the IWB, so she asked one of the students to do that, but he could not. Then she called one of the teachers in the school and asked her to solve this problem. Another teacher came to help and show her how to do it. She was upset and unhappy about this problem. She continued teaching how to do another example, and then asked the students to do it on their computers. She showed them four examples, and then at the end of the lesson, she allowed them to use their computers and do some painting. The students were please about that and enjoyed it very much. Teacher R in the interview stated that she would probably not experience stress if there was an assistant teacher in the classroom, and she would feel safer.

Teacher R seems to hold a negative attitude towards technology. She thinks that she would not be able to use it in perfect way and does not trust the use of technology. She told the researcher that she has been learning about technology, also she does not use it other than for teaching, and she is new to technology "... and then you've got the technology on top which as a new convert to technology, I'm still learning. So very sort of inexperienced and unsure about technology. So there's the two things working together". When errors occurred while teaching with the technology it was possible to see that she became upset; on some occasions her face became flushed, and it appeared that she was unable to solve the problem. Then after a short period of thinking and after asking the students if someone could solve the problem, she called on another teacher for help. "If there wasn't anybody here I couldn't remedy them so it's a bit of a two-edged sword". The misfit between teacher R and her technological environment is clear here in the form of 'ability and demands', it was clear that her abilities and skills do not match the demands of her technological environment, and this misfit causes stress to her. Moreover, looking at the nature of the causes of technostress she experienced, they could be related to workload type of complexity. With respect to her level of skills and abilities, some demands were considered as to add more work, and push her to learn about technology.

When she was asked about symptoms of technostress she experienced, she stated. "Your mouth goes dry, um, you feel butterflies and get hot it's all that sort of thing and sometimes I can even feel the blood pumping round my hands, Yea? It's all those things. It makes you feel uncomfortable, and then you become more sensitive. My goodness you know I'm feeling a bit strange and I hope I'm going to be OK and that makes you feel that bit worse. You worry about that as well". This explanation demonstrated how she was suffering, and the difficulty she was facing when she was technostressed. During her session, she faced some problems with technology; she was using the technology in uncertain and cautious ways. This way of dealing with technology, her perception about herself and about the technology, the cautiousness were some factors that played an important role that make her feel helplessness and thus experienced high technostress.

For coping with technostress, she would ask her colleagues for help. "You know talking to your colleagues, um, because you know that everybody is in the same boat so that has a sort of calming effect, you know you are not alone".

Teacher R is of age 35 or more, with negative attitude, does not use technology a lot, when she uses technology she uses technology in a very simple way (due to poor skills). Few and simple errors occurred in her technological classroom, but they did make her stressed. She seems to be among those who experience high level of technostress, and that is clear in her explanations about the symptoms, when she stated, "Your mouth goes dry, um, you feel butterflies and get hot it's all that sort of thing and sometimes I can even feel the blood pumping round my hands, Yea? It's all those things".

### 7.4.5. Discussion

The analysis of the data in the survey and in the classroom investigation has helped to describe technostress. The case studies show something about how this plays out in the classroom, and how the causes of stress can be conceptualised as a misfit between the teacher and the technological environment, and how this misfit generates stress. The model that have been designed (Teacher-Technology Environment Interaction Model) takes the fit/lack of fit as a basis to explain stress, and this can be seen in some examples from the case studies above. See for example teacher R who stated that "When things go wrong and you have an audience my goodness you know this is not what I really want to happen. And it is really very stressful ... I think it's the fear of the unknown. I mean, even if I was the most computer literate person in the world and what I was doing depended upon the technology ... you know ... what do you do? It's all sort of ... stressing out". Teacher R is giving an example of a threat she expected from the technological environment 'Thing goes wrong' (TE) and her perception of the threat might increase because of the audience (TE). Her feeling about the situation is an example of 'primary appraisal'; also her belief about herself as not " the most computer literate", and that leads her to think that she won't be able to cope with it (T) and this is an example of 'secondary appraisal'. The lack of fit between what she expected to 'go wrong' and her ability to deal with it results in stress as she explained. This is an example of the demand and ability (D-A) form of misfit.

Teacher ST described the lack of support in technological environment, which he had experienced before. He stated that "I got this ... software which I said it is so good I have had two years it is not on the network all that time I have not been able to use it because I have to wait for an IT technician to install it, you have really want to use software to push for it to be installed in the network". Lack of fit between the need and the supply is clear in this example. In this example, teacher ST was not able to install the software and asked for support from a technician, which was not forthcoming. This leads to lack of fit between the teacher's need (T) and the environmental supply (TE). Such situation caused frustration because he said it was good software but could not use it in his classroom.

Teacher S describes a situation as follows: "That active vote thing I don't know why that doesn't work, last week it was working, today it doesn't work – I have no idea why so that was really like, but maybe it's more frustrating than stressful - it's both - frustrating and stressful – because it's frustrating and then a little bit of stress comes with that because your thinking – you know - 'it's not working – I can't do what I planned". She needs the vote instruments to work in proper way as it did in the last week (T - need) but unfortunately they did not work, so she could not use it in front of her students (TE - supply), and this lack of fit causes stress.

Teacher P said in one of the sessions, "This was not a very stressful lesson was it? ... Yes if it was Friday afternoon with class year eleven I think you will probably go up your scale haah, because this to me I felt like a holiday lesson because the computer was doing all the work, I felt that I was not doing anything". In her explanation, she stated that the computer did (TE - supply) all the work she needed (T - need) in this class, so there was a fit between need and supply, therefore she felt no stress and the lesson was just like a 'holiday' as she had expressed.

In another case, this teacher was asked by her students to help them to save their work or open their files on their PCs (TE - demand). Although she was able to help her students (T - ability), she felt that this wasted time during the session, which increased her (workload - TE – demand) and she was not able to deal with it (T - ability), and therefore she experienced stress.

Many other examples were found in the case studies in which the researcher could identify lack of fit in both forms A-D and N-S and often to relate the situation to one of the types of complexity, and where stress was observed as a consequence.

There was often a misfit between ability and demand. The teachers' abilities, attitudes, degree of familiarity with using technology, and the extent of training, misfit with the demands of the environment including level of performance of the technology, errors, difficulties of use, and the need to prepare and teach students.

The way they express their experiences of technostress were different from one teacher to another, also the ways they used to deal with it were different from each other. For example, one teacher stated that he would not waste his time using stupid computers, whereas another teacher said that she would use it many times and learn how to use it before she brings it to the classroom. In the first example the teacher expressed his negative attitude when he used the term 'stupid' and confirm that he did not use it for long time and felt anxious, whereas the other teacher who likes to use it and learn about it stated that she experienced frustration only if it did not work.

The lack of basic skills in using the software needed required in the lesson is illustrated in the case of teacher R who did not have the skills to drag the line on the IWB. The researcher interprets these lacks of skills in terms of a misfit between the demands of the lesson and the teacher's ability to meet those demands, and so would expect them to result in feelings of stress.

The use of the case studies has thus enabled a more detailed examination of the T-TE model and in particular, the issue of subjective misfit.

## 7.5. The main results

The survey had enabled the researcher to get a general perspective about causes of technostress, its symptoms, and coping strategies. The analysis of the data from the classroom investigation enabled the researcher to get a better description of these causes, symptoms, and coping strategies. The analysis using NVivo provided some detailed descriptions of examples of these categories and enabled the researcher to get clearer view of what they mean in practice. This analysis highlighted some specific errors and some problems due to pupils' misuse of technology but also pointed up some positive experiences about technology.

The classroom investigation showed evidence of all of the three types of complexity that have been identified in the literature review (see section 7.3.3), and coupled with evidence relating to two of these from the analysis of the open-ended questions in the survey this supported the idea that the complexity might be a useful concept in discussing aspects of the causes of technostress.

The stressful nature of technostress (see section 7.3.4) is supported by the reporting of a range of symptoms, including:

- Frustration, irritation, annoyance (psychological symptoms).
- Headache, sweaty, got hot, change in the GSR reading, tiredness (physical symptoms).
- Shouting, leaving technology, and drinking a lot of water during teaching (behaviour symptoms).

Coping strategies were noticed and reported by teachers (see section 7.3.5). Problem-focused coping strategies such as trying to fix the errors, seeking technical support, training, and managing were reported. In addition, emotion-focused coping strategies such as blaming themselves, and getting used to problems were reported by some participants.

This NVivo analysis did not enable the researcher, however, to understand clearly the interactions in the classroom and the misfit between the teacher and their environment. It was not clear how the interaction between the teachers and their environment led to the misfit that cause technostress. Therefore, four case studies were constructed in order to show something more about the interaction in the classroom; hence, how a conceptualisation of causes of stress as misfits between the teacher and the technological environment might enable the researcher to examine stress more closely.

Earlier, the survey had suggested an association between the variables of age, attitude, and use and the experience of technostress. This association was confirmed to some degree within the case studies. Looking at the behaviour of specific teachers when dealing with specific issues in the classroom provides a number of examples. Teacher S was a confident user of ICT, teaching other teachers, with a positive attitude, she could deal with most problems, experienced relatively little stress, but was most concerned about audience – perhaps not surprising since she was teaching other teachers. Teacher P had adopted a straightforward approach to using technology, used technology a lot, had a positive attitude, and was well practiced and prepared and so hit few problems and was little stressed. Teacher ST used technology less, held a negative attitude, and had adopted methods of avoiding technology - it seems he was quite successful in doing this, but such strategies added problems to him from his students' demands, also using such strategy might be understood as a way used to prevent technostress he experienced before. Teacher R was someone who felt she needed to use technology but was far from comfortable; she did not use technology a lot, had a negative attitude, and for her the use of technology was clearly associated with stress. These examples throw some light of technostress is experienced by a range of teachers with rather different characteristics.

# Chapter Eight

## DISCUSSION

### 8.1. Introduction

This chapter looks at the empirical results in relation to the main research questions. In addition to this introduction, this chapter consists of eight sections dealing with technostress: causes, complexity, symptoms, coping, the T-TE model, the contributions of the study, and the limitations of the study.

### 8.2. Technostress

#### 8.2.1. Introduction

The study first aimed to demonstrate the existence of technostress in the technological classroom and to look at the relationship between this and 'background' variables, including age, gender, type of school, time of use of technology, and attitude towards technology. The specific research questions related to this aim were:

*Is there a relationship between technology use and teacher stress in the technology-rich classroom?*

- *Do teachers report that the use of technology causes stress?*
- *Can evidence for this be found in classrooms?*

*Does increased use of technology result in increased stress?*

*Is there an association between the attitude towards technology and the individual's report of experiencing technostress?*

*Is this experience of technostress associated with age, gender, type of school, attitude, and amount of use of technology?*

#### 8.2.2. Technostress in the Literature

Technostress is stress that is experienced by the individual when using technology in a technological environment. A review of the literature suggested that technostress was not experienced differently in any important way from other kinds of stress and affected individual well-being in the same ways. Technostress has been investigated in workplaces, and a range of literature has pointed to increased experience of stress when people deal with technology (e.g. Brod, 1984; Weil and Rosen, 1997). In education, however, relatively few studies about technostress have been conducted (examples include: Hedberg, 1989; Hudiburg 1996; Humphery, 2000; Burke, 2005). Some studies in the literature discussed evidence for the existence of technostress in terms of the elements associated with all forms of stress, that is causes, symptoms, and coping strategies (see section 3.1). Causes of technostress were described as being factors related to job characteristics, factors related to organisations, or/and factors related to users' characteristics (see section 3.2). Many of the studies in the literature investigated a range of factors of each characteristic – job, organisation, and person – separately, but there remains the possibility of using the psychological approach, investigating the origins of stress in the transaction between the individual and the environment. Symptoms of technostress were found to fall into the same categories as the symptoms of other kinds of stress i.e., physical, behavioural, and/or psychological (see section 3.3). Coping strategies were either emotional-focused (e.g., relaxation) or problem-focused (e.g., training), similar to ways of coping with other kind of stress (see section 3.4). Some studies in education related technostress to computer-related anxiety (see Genco, 2000) and others to 'perceived technical competence' (Shamoail, 2005).

Building on the P-E fit model the 'Teacher-Technology Environment Interaction Model' was designed as a model of technostress in the classroom (see section 3.5), in which technostress was described in terms of a lack of fit between the user and his/her technological environment. The researcher has not come across any other studies in education that have adopted similar definitions of technostress in the classroom.

In section 3.2 it was stated that a number of studies have investigated the relationship between stress and factors such as age, gender, and type of school (Johnstone, 1989). Some studies have found a relationship between technostress and age (see Clute, 1998) but Hudiburg and Necessary (1996) found no correlation between age and technostress. Dyck and Smither (1994) and Coovert et al. (2005) found a significant relationship between age and computer anxiety, but Yang, et al. (1999) found no relationship between age and computer anxiety. Younghusband (2003) found little relationship between age and stress appraisal. So overall, there is some evidence of an association with age, but perhaps more evidence suggesting that there is no relationship.

Similar findings apply to gender. In some studies small differences have been found for computer anxiety (King, et al., 2002, Coovert, et al., 2005), technostress (Elder, et al., 1987, Voakes, et al., 2003, Ogan and Chung 2003, Jyh-Rong and Shih-Wen 2007). Some studies suggest that whatever differences used to exist these are now abating (Larson, et al., 2002 p. 129, see also Whitely, 1996)

As regards other background characteristics, Yang, et al., (1999) found no relationships between computer anxiety and ethnic/cultural background, and teaching/professional area.

Looking at studies that examine the user's knowledge, skills, and attitudes with respect to technology-related stress, this study has a similar mixed picture: Studies have found a relationship with:

- past experience with computer (Bozionelos, 2001).
- perceived control (Clute, 1998).
- computer skills (Shepherd, 2004).

Others found no relationship with:

- computer experiences (Ballance and Ballance, 1996)

### *8.2.3. Existence of Technostress*

The evidence from the study about reported causes, symptoms, and coping behaviour suggest that teachers are well aware of technostress. In the survey technostress was seen by 53% of the participants as a somewhat serious problem, 21% viewed it as serious, and 6% as a very serious problem (see section 6.2.1). Most commonly reported as high causes of stress were 'technology problems' (54%), followed by 'networking problems' (28%), 'more demands' (24%) and 'information overload' (22%) (see section 6.2.2). In the analysis of the responses to the open-ended survey questions, the data related to causes was coded at the nodes 'technological problems', 'time wasting', 'lack of support', 'pupils' and 'teachers' (see 6.5), and the same factors were found in the analysis of the classroom data (see section 7.3.2). The case studies showed some specific examples of causes of technostress, such as the inability to deal with technological problems (arising in this case from the use of voting instruments) in the case study of teacher S (7.4.1). The symptoms of bad temper (59%), mental fatigue (41%), and headaches (35%) were the most commonly reported in the survey. Physical symptoms such as; shortness of breath, tiredness, and rising of blood pressure; psychological symptoms such as frustration, irritation, annoyance, and anger; and behavioural symptoms, such as shouting and moaning, were reported in the open-ended data. Frustration as a psychological symptom, headache and sweating as physical symptoms, and shouting at students as behavioural symptoms were found in the classroom investigation (see section 7.3.4). In the case studies, frustration and anxiety were seen as examples of symptoms (see sections 7.4.1 and 7.4.3). In the responses to the open-ended questions (see 6.5.4), emotion-focused coping strategies, such as drinking too much alcohol and avoiding the use of technology, were reported as well as problem-focused strategies, such as training and using a backup plan. In the classroom investigation, asking for help from technicians as a problem-focused strategy and relaxation as an emotion-focused strategy were observed as examples of coping strategies (see section 7.3.5)

Is there any evidence arguing that technostress does not exist or that it is not a significant problem? The researcher has not found any study in the literature that has argued that technostress in the classroom does not exist. In the survey technostress was seen by 8% of the participants as not a serious problem and 11% reported that they had 'no idea'; when teachers were asked whether their level of stress due to the use of technology had increased during the month preceding the survey, 3% of the participants reported that their level of technostress had decreased, and 12% reported that they had 'no idea' (see section 6.2.1). In the case studies, two of the teachers did not really accept the existence of technostress. One teacher thought it was just like any other stress, there was nothing special about it (see case study of teacher S 7.4.1); and another teacher said it caused some anxiety, but again he did not really accept technostress as a description (see case study of teacher ST 7.4.3).

The majority of the evidence points to technostress as a significant issue in the lives of teachers using technology in the classroom. It is not experienced by everyone, and even where experienced, it is not always felt very acutely, but for many it is a significant issue. The case studies provided detailed descriptions of the experience of technostress. For example, Teacher R (7.4.4), who was over 35, with a negative attitude towards technology, who did not use technology a lot, and was not comfortable with it, nevertheless felt she needed to use technology; for her the use of technology was clearly associated with stress. She expected threats, "Things go wrong" ('primary appraisal'), and felt she was not able to deal with them, describing herself as not being "The most computer literate" ('secondary appraisal'). When asked about her experience of technostress, she admitted that she experienced technostress.

The experience of technostress was associated with a number of factors. Technostress tended to be associated with age, negative attitudes towards technology, and less use of technology in teaching. Participants aged 35 and under used technology more than their older colleagues. A possible reason why fewer of those aged 36 or more work more with technology is because of their generational profile in relation to the development and introduction of ICT in education (however, it might also be that the older teachers were in positions of greater responsibility within their schools, and this may influence the way they work with technology). There were significant relationships between the variables gender, age, amount of use of and attitude towards technology and the likelihood of labelling particular causes of technostress as high or medium. There were significant relationships of the variables age, attitude, and amount of use of technology with one another. All these three factors influenced the reported causes of technostress, indicating that older teachers, teachers who hold negative attitudes, and those who use technology less do experience more stress (see section 6.3.5). The results showed no significant relationship between the variables gender, kind of school, and attitude, and amount of use.

It was seen that there are a number of studies that found a relationship between age and technostress, but other studies that do not find any relationship. The present study finds an association between age and technostress, though see the discussion below. The literature also provides examples of studies showing a relationship with gender, and others no relationship. This present study also found no relationship with gender.

In order to get a deeper insight into the relationship between the three variables of age, attitude to technology and amount of use of technology, four groups of teachers were identified in the classroom studies, and case studies of a teacher from each group were constructed:

Teachers of age 35 or under; with a positive attitude to technology, who use technology a lot.

Teachers of age 36 or more, with a positive attitude to technology, who use technology a lot.

Teachers of age 35 or under, with a negative attitude, who do not use technology a lot.

Teachers of age 36 or more, with a negative attitude to technology, who do not use technology a lot.

The case studies illustrated the relationship between the three variables of age, attitude to technology, and amount of use of technology with technostress. It could be seen in these that age alone was not a crucial factor, it was the attitudes to the use of technology and the amount of use that tended to impact on the level of preparedness of the teacher for using technology.

Interestingly those who use technology for longer were found to be less likely to report a number of causes of technostress as 'high'.

The study found some evidence that poor skills can cause stress – the main evidence for this lies in the expressed desire for in the survey asked for training and related the inadequate training to the stress (see section 6.5.1). Some examples were found also in the classroom investigation (see section 7.3.2). In the case study of teacher R (see 7.4.4) she admitted that she was not good in using technology, and thus the use of technology was clearly associated with stress. This was supported by Shepherd (2004), who found in his study that there was a link between poor skills and experience of technostress among faculty in the Colleges of Business and Education and academic librarians.

## 8.3. Causes

### 8.3.1. Introduction

This next section relates to an investigation of the causes of technostress. The research questions about causes were:

*What are the main stressors associated with technostress?*

- *What do teachers report as the main causes of technostress?*
- *What are found to be causes of technostress in the classroom?*

Much of the literature conceptualises causes of stress as independent of the individual, and this study will, to some extent, adopt that way of talking about causes for the purpose of the first part of this discussion; but it is important to remember that the view, that this study argues, is that causes, for example, errors or isolation, do not cause stress to a user unless he/she considers them as stressors and responds to them in that way. The study argues that stress arises not from these factors in themselves but from a lack of fit between these environmental factors and personal factors.

### 8.3.2. Technostressors in the Literature

The main causes of technostress identified in the literature were factors related to job characteristics, factors related to organisations, and factors related to users' characteristics. Job characteristics were things such as social characteristics (e.g., isolation) and two kinds of technological characteristics; those related to performance (e.g., errors) and those related to the impact on the user (e.g., information overload). Organisational factors were things such as inadequate training and lack of technical support. Personal characteristics were things such as hesitancy, and negative attitude towards technology. Technological characteristics (performance) included problems of technology: problems of hardware and software, computer lock-up, and loss of in-put (Hudiburg and Necessary, 1996), badly designed software (Kupersmith, 1992), poor system performance (Carayon, et al., 1999), malfunctions and interruption (Johansson-Hiden, et al., 2003), computer runtime problems (such as hardware failure, computer crashes) (Shepherd, 2004), networking and computer hardware problems (Kupersmith, 2005), inadequate media quality (Wilson and Sasse, 2000), long response times and unexpected stoppages (Aborg, 2002), system response time (SRT) (Trimmel, et al., 2003), and errors and using new application (Humphrey, 2000). Technological characteristics (impact on the user) were things such as workload (Carayon, et al., 1999), information overload, uncertainty, pace (Weil and Rosen, 1997; Harper, 2000; Kirsh, 2000; Kupersmith, 2005), computer information problems (such as difficulty keeping up and too many passwords) (Shepherd, 2004), techno-overload, techno-complexity, and techno-uncertainty (Wang and Shu, 2005), and conflicting goals (Hamborg and Greif, 2003) (see 3.2).

### 8.3.3. Causes of Technostress

In Table 1 in section 3.2 the causes of technostress found in the literature were summarised in this way:

1. Job characteristics
    a) Social characteristics
    b) Technological characteristics (Performance)
    c) Technological characteristics (Impact on user)
2. Organisational factors
3. Personal characteristics

This present study did not attempt to look for those job characteristics classified as Social characteristics.

The questions in the survey do not map neatly onto the categories derived from the literature, but a reasonable mapping might be:

***Technological characteristic (Performance)***
Technology problems
Technology physical problems
Networking problems
Application software
Web sites

***Technological characteristic (Impact on user)***
Information overload
More work required
More demands
Too much change
Security issues
Complexity
Multi-tasking
Compatibility
Uncertainty

*Organisational factors*

New learning required

When the researcher looked at the data from the open-ended questions and the classroom investigation (see sections 6.5.1 and 7.3.2), he identified the following categories related to causes: Technological problems, Time wasting, Pupils, Lack of support, and Teachers. The three categories Technological problems, Time wasting, and Pupil related to the area covered in the literature by the two categories Job characteristics - Technological characteristic (Performance) and Technological characteristic (Impact on user). The two categories Lack of support and Teachers corresponded to the categories 'Inadequate training' and 'Lack of technical support' under Organisational factors from the literature.

In the account of the causes of technostress given below, the study organises the account according to the two main headings of Job characteristics and Organisational characteristics. In discussing the results of the survey, the study distinguishes Job characteristics related to Technological characteristics (Performance) and Technological characteristics (Impact on user), but in discussing the results of the open-ended questions and the classroom investigation, the study uses the categories Technological problems, Time wasting, and Pupils. In discussing the Organisational characteristics, the study uses the two categories Training (equivalent to the Teachers category) and Lack of support. The study has already discussed in 8.2.3 above what are here classified as Personal characteristics and so does not discuss them again.

The following section discusses the causes of technostress that related to job characteristics and organisational factors. After discussing these characteristics and factors there is a discussion about the types of complexity, to which some of these characteristics and factors were related.

#### 8.3.3.1. Job characteristics

As it has been explained, the researcher used a different classification system for job characteristics for the data from the survey and the classroom investigation, so the study discusses the survey results and the classroom investigation separately, and then later brings these observations together.

The factors found in the survey can be classified firstly as Technological characteristics (performance), which were principally technological errors of one type or another. In the survey, the causes commonly reported as high or medium causes of technostress were: 'technology problems' which was classified as a high cause of technostress by 54% of the participants; and 'networking problems' was classified as a high cause of technostress by 28% and as a medium cause of technostress by 32 % of the participants (see section 6.2.2). The second category was Technological characteristics (the impact on the user). This is illustrated by the five causes commonly reported as high or medium causes of technostress in the survey 'more demands' classified as a high cause of technostress by 24% of the participants; 'information overload' classified as a high cause of technostress by 22% of the participants, 'too much change' classified as a high cause of stress by 17% and as a medium cause of technostress by 34% of the participants; 'uncertainty' classified as a high cause of technostress by 13% and as a medium cause of technostress by 36% of the participants; and 'security issues' classified as high cause of technostress by 8% and as a medium cause of technostress by 36% of the participants (see section 6.2.2).

For the analysis of the responses to the open-ended questions in the survey and the classroom investigation, the researcher coded the data at three nodes 'technological problems', 'time wasting', and 'pupil's use of technology, which covered the same area as the categories Technological characteristic (Performance) and Technological characteristic (Impact on user). The reasons for making this change to the classifications was principally related to the discovery in the data related to pupils' use of technology which was not mentioned in the literature, and partly because the study chose to classify data which related to increased work as a result of pupils' use of technology, which might otherwise have been classified as a workload (technical characteristics- impact on user) at this node as well. In this example the researcher had three options to put this factor under technological problems, workload, or pupils' use of technology, so it was decided to put it under the latter. The reason was that this factor (teaching student basic ICT) was not a problem caused by directly by the technology, it was not workload added by the technology, but was generated by the less skilled students.

### Technological problems

41 units were coded as being about technological problems in the open-ended data (see section 6.5.1). In the classroom investigation, 42 units were coded as being about technological problems (see section 7.3.2). Some examples were found in the case studies, with teachers reporting that sometimes they could not deal with technological problems, for example, teacher S reported technological problems with the printer and the voting instruments (see section 7.4.1). Some teachers indicated that difficulties when they used technology were a source of stress, one said "When things are usable, you stress less". Other examples from teachers' interviews included statements that teachers need "more reliable equipment", "technology that works consistently", and "reliable systems, with back-up instantly available in case of breakdown". In such situations some teachers blamed themselves, whilst others disliked being in such situations in front of their students, because they felt that their students expected them to be able to handle everything in the classroom, and that seeking help from colleagues and technicians in order to solve problems also made them look incompetent. Teachers put the factor 'technology problems' in the leading position of the factors that were reported being associated with stress. In the open-ended data, 41 of 167 units were coded as 'technology problems', and in the classroom investigation 42 of 108 units were coded as 'technology problems'.

A particular subset of technological problems was teachers' perception of some software as badly designed: Teachers often commented on this issue, some of the specific concerns found in the interviews (see section 7.3.2) were:

- Some software packages have long and unnecessary introductions. One teacher felt that there was no need to list what the teacher will see in the software: "There was a lot of introduction and that wastes your time and detracts you from what is important so we did not need to be told we are going to see this and this and this".
- Some software paused at the wrong point. One teacher stated that "I had to do the narration and the software does not stop, or at least it does stop but it stops a pause at the wrong point, so when you demonstrating the software, so that would be much better if it paused at the end of each section".

- A number of teachers reported poor navigation in the software they were using.
- One teacher emphasised the need for a place for the pupils to create a summary in the software, which should include his/her learning progress and comments about the topic to enable the student to refer to it at any time. The teacher stated "There was no summary [in the program] at the end students have to do their own summary [on their notebooks] it would be good to have summaries where you had the four test tubes labelled with what you had added and what colour change so when they start doing the test they would have that summary on the screen".
- A number of teachers felt that the software they were using was difficult for the pupils to use. Sometimes they argued that this was because the software was designed with adults in mind and that the design had not considered the capabilities of students of different ages.
- Some teachers in this study thought that software programs should distinguish between girls and boys. Among teachers interviewed, some stated that boys do not want to be given advice unless they have asked for it, whereas girls appreciate advice.

#### Time wasting

Time wasting was another important cause of stress reported by teachers. They argued that though technology was supposed to save their time, yet they found that in some situations it did not. Examples of this were observed in the classroom investigation and were reported by some participants in the survey. 10 units were coded in the answers to the open-ended questions (see section 6.5.1) and 17 units were coded in the classroom investigation (see section 7.3.2) at the 'time wasting' node. Things which wasted time included fixing errors, downloading, getting access, saving students' work, and waiting for technology to work. Preparation was reported in the classroom investigation, as adding load to teachers (more discussions in 8.4.3). This time wasting interrupted teaching and students' learning, and led teachers to worry and, therefore, experience stress.

### Pupils' use of technology

The difficulties that pupils have in their use of technology can create additional difficulties and so sources of stress for the teacher, sometimes affecting the progress of other pupils and interrupting teaching. Some teachers put the difficulty that pupils had in using software down to the software design, arguing that it had not been designed for use by children; others argued that pupils should follow courses on IT before being expected to use technology to support the learning of other subjects. Some examples of this were found in the survey and the classroom investigation (see sections 6.5.1 and 7.3.2). Examples of things teachers said included: "Schools need someone to take charge of IT across the curriculum to ensure all students get a range of IT experiences and that work in one subject is built on in another", "Students accounts are generally poorly managed and the NC [National Curriculum] for IT does not focus enough on basic housekeeping and keyboard skills that could transform the learning of the least able pupils across the curriculum".

### *8.3.3.2. Organisational factors*

In the literature organisational factors refer to such things as unmet employee requirements or aspects of the organisation and its management that might cause stress. Organisational factors include the structure, the climate, the culture, and the political environment (see section 2.4.1), in a technological environment, organisational factors also include lack of technical support, inadequate training, poor ergonomics, and electronic performance monitoring (see section 3.2)

In the survey 'new learning required' was reported as a high cause of technostress by 19% and as a medium cause of technostress by 35% of the participants (see section 6.2.2). In the open-ended and the classroom investigation, two categories namely 'training' and 'lack of support' were related to organisational factors.

### Training

Sometimes there were no problems with the technology, but teachers were not able to use it (see sections 6.5.1, 7.3.2, and the case study of teacher R 7.4.4). Teachers sometimes made mistakes in their use of technology in the classroom, and this could produce problems. Some teachers felt that some faults and errors arose from lack of confidence and poor training. Data from both the survey and the classroom investigation indicated that though some teachers felt that the technology was easy to use because they were trained to use it, others saw training as a factor which they lacked and this was the most problematic factor for them. They emphasised the need of teachers taking courses about technology and practising new software they may have to use in their classrooms. Obtaining training was not necessarily easy; some teachers emphasised that they were busy all the time and could not find any time for training, thus adding another load onto them in their teaching environment. It has been noted in previous research that the additional time spent learning to use the new technology itself contributed itself towards technostress in teaching (see, for example, Bai, et al., 2000). Moreover, the pace of technological change and the need to keep up could add further to their load. Some teachers felt that learning about technology seems to have no end point but just continues.

Training on the use of technology has been pointed to in many studies (see, Rosen and Weil, 1995; Clute, 1998; Cox, et al., 1999; Bitner and Bitner, 2002; Willis and Cifuentes, 2005). Other studies have argued that it is important to develop an appropriate pedagogy in the use of ICT in education, and then train teachers in using that pedagogy (see Cox, et al., 2004b; and Cox and Marshall, 2007). In their comprehensive review (Cox and Marshall, 2007) stated that "there is ... a fundamental misunderstanding by many teachers and even teacher trainers about how to incorporate ICT in their whole teaching programme" (p. 67). They argued that studies "have found that very few teachers have a comprehensive knowledge of ICT nor are confident in using the wide range of ICT resources now available in education. These limitations have been shown to affect the way the lesson is conducted and therefore any research outcomes" (p. 65), Cox and Marshall concluded that "training programmes need to include showing teachers new instructional strategies, learning about new forms of knowledge representation and how to rethink the curriculum and the classroom uses of ICT" (p. 68).

### Lack of support

Many teachers in this study reported that they needed technicians to help solve technical problems. Some teachers who were interviewed reported that they do not have technicians in their schools. Other reported that there are technicians in their school, but they are continuously busy all the time and could not be found when they were needed. Some examples were reported in the classroom investigation (10 units were coded as 'lack of support', see section 7.3.2) and in the survey (48 units were coded as 'lack of support', see section 6.5.1). One example was discussed in the case study (see section 7.4.3), where one teacher was not able to install the software, and asked for support from technician, which was not forthcoming.

Some teachers saw the help provided by the 'coordinator' as an important support. They think that the support by these coordinators might meet their needs and thus reduce causes of stress. A teacher from a secondary school explained why she thinks that provision of a coordinator in her school was important "I think in schools we've got teachers and we got IT technicians. I think there is a room for another layer. Someone who manages the integration of the IT into the curriculum, who stands between the technicians and the teachers working out because there may be constraints about the server or the way they were not co-operating that teachers are not aware of. So we are pushing from one side and the technician is resisting putting the software on, because we do not understand how the network works we don't have sympathy for them they don't have sympathy for us, we need someone in the middle really whose concern is to see that IT is integrated across curriculum".

### *8.3.4. Discussion*

A number of factors discussed in the literature as causes of stress were not found in this study: isolation, invasion, monitoring workers, conflict, and disruption. Some of this is because of the methods of data collection – the study did not focus on the problems outside the classroom, and so some general factors, such as invasion and isolation, were not investigated. The simple use of technology for monitoring teachers did not exist in the classroom, and so this was not a factor the study looked for.

Many factors, such as technological problems, time wasting, training, and lack of support, were a match with what have been discussed in the literature.

Some authors consider experience and attitude towards technology as causes of technostress, but the researcher preferred not to think of these as 'causes' in this way and has initially described them as background variables, which enabled us to distinguish groups of teachers. However, in the study's fuller account of the causes of technostress, the study will consider these as personal variables, which may or may not fit with the requirements of the technological environment.

Many factors in the literature were listed and considered as causes of stress per se. This study looked at these factors in a different way. The argument we hold says that the cause of stress is the lack of fit between such factors/events and the individual's characteristics. The understanding of the nature of the factors found in the literature helped the researcher to determine his investigation. The study looked at the transaction with these factors and asked whether it caused stress. For example, some teachers reported that they could not deal with errors and saw them as causes of stress in their classrooms, but some teachers see errors as a challenge and did not experience technostress when they occurred, so the study would not argue that the errors cause stress per se. The case studies enabled us to get a clearer view of the transactions between the person and the environment and why they resulted (or did not result) in technostress.

Factors such as support and pupils were found to be associated with stress in normal classrooms. These factors were also noticed and reported in somewhat different forms in technological classrooms.

Pupils' difficulties in using technology and the preparation of technology were new factors found in this study. Previously, the 'misbehaviour of students' factor was considered as being one of the most frequent causes of stress in teaching. Less skilled students were found in this study as one of the most common factors that were associated with stress in technological classrooms. Also, lack of support from schools, parents and colleagues was reported previously in normal classes. Now with the existence of technology, teachers need support from technicians. Additionally, preparation for sessions was a factor attributed to stress in teaching (Bubb and Earley 2004). Nowadays teachers spend some of their time preparing technology for students in the classroom. Moreover, they have to prepare themselves by learning about technology before using it in front of their students. The technology-rich classroom is the site of much the same potential causes of stress as the normal classroom, but that these may sometimes take on somewhat different forms.

In summary, the main factors reported in this study that are associated with technostress were technological problems (including errors, networking problems, badly designed software, more demands, preparation, uncertainty, information overload); time wasting; pupils' use of technology; lack of support; and teachers' lack of training in the use of technology.

Many studies have adopted the approach of listing possible causes of stress and asking participants to select what they thought of as causing stress to them. Cooper, et al., (2001) have argued that many such studies make claims to be using a transactional approach at a theoretical level, but in reality they are often using an interactional approach in practice. The present study might be in danger of doing the same thing, and lists of possible causes derived from the literature may have had an undue influence on the researcher. It is better to let the participants to determine the causes, as he or she knows what causes threat to them and whether they can cope with them (as Lazarus, 2006 argues). Causes are what the individual sees not what the researcher sees. The cause of stress is the misfit that is recognised by the individual. In this study, the use of open-ended questions in the survey and the classroom investigation allowed the participating teachers to express their feelings about what causes were seen as threats by them.

## *8.4. Complexity*

### *8.4.1. Introduction*

Complexity is often used in a fairly general sense in the literature to refer to 'being made up of many interrelated things' but for others it has a more technical meaning. Job complexity is associated with 'qualitative over-demand', which refers to "work demands perceived as too difficult to complete satisfactorily" (Blasé, 1986, p: 23), variety, significance, autonomy, work load, skill level needed (Shaw and Gupta 2004), task identity, and feedback (London and Klimoski, 1975), opportunities for personal responsibility, control, and self-direction at work, (Oldham and Gordon,

1999) and degree of demand, challenge, and stimulation (Fried, et al., 2001). Many of what has been so far called causes of technostress or factors related to technostress classified as job characteristics are also related to the concept of job complexity. Tables 65 and 66 (adapted from the tables in 6.5.2 and 7.3.3) show the overlap between the coding of causes and complexity in the open-ended questions in the survey and in the classroom investigation.

| | Complexity | | Other |
|---|---|---|---|
| | Unpredictability | Workload | |
| JOB CHARACTERISTICS (53 units) | *8* | *15* | *30* |
| Technological problems (41 units) | 8 | 11 | 22 |
| Time wasting (10 units) | | 3 | 7 |
| Pupils (2 units) | | 1 | 1 |

**Table 65: Complexity and causes (open-ended questions in the survey)**

| | Complexity | | | Other |
|---|---|---|---|---|
| | Unpredictability | Workload | Simultaneity | |
| JOB CHARACTERISTICS (75 units) | 27 | 18 | 6 | 24 |
| Technological problems (42 units) | 25 | 13 | 2 | 2 |
| Time wasting (17 units) | | 2 | | 15 |
| Pupils (16 units) | 2 | 3 | 4 | 7 |

**Table 66: Complexity and causes (classroom investigation)**

In the closed questions of the survey, the correlations between the listed causes showed two groups of inter-related variables:

a) More work required, more demands, too much change, new learning required (with new learning required also correlating to complexity)

b) Multi-tasking, compatibility, uncertainty, and complexity

These two groups show some relationships with the concept of complexity. Group (a) related to workload, and group (b) related to unpredictability and simultaneity. These relationships supported the idea that there were clusters of causes that could reasonably be called complexity (6.2.2).

The causes listed in the survey questions[9] whose modal rating was 'high' or 'medium' can be grouped according to the categories of complexity as follows (with technology problems appearing in both categories):

***Workload***

Technology problems

More demands

Information overload

Too much change

Security issues

***Unpredictability:***

Technology problems

Networking problems

Uncertainty

[For the sake of completeness, the causes whose modal rating was 'low' can be classified as follows:

***Workload***

Application software

Complexity

More work required

***Unpredictability:***

Technology physical problems

Application software

Web sites

Compatibility

Complexity

***Simultaneity***

Application software

Multi-tasking

Complexity]

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[9] This list omits 'new learning required' since our discussion of complexity will relate to job characteristics alone, and we will classify 'new learning required' as an organisational characteristic.

The issue is whether the use of the concept of complexity can add anything to the understanding of context in which technostress occurs, so the following research question was proposed:

- *To what extent can we relate causes to forms of job complexity?*

### 8.4.2. Complexity in the Literature

The literature described a range of different types of complexity in the classroom - unpredictability, workload, simultaneity, and immediacy (Doyle, 1986) (see section 4.3). Workload refers to the large quantity of events and tasks in the classroom with which teachers have to deal. Unpredictability refers to events and outcomes that take unexpected turns. Simultaneity refers to managing more than one task at the same time. Immediacy refers to the immediate action required from teachers in order to deal with the rapid pace of classroom events (see Doyle, 1986; and Sandholtz, et al., 1997), such events that need immediate action are unpredictable and cannot be controlled, and so the factor of 'immediacy' in this study was incorporated under the general heading of unpredictability.

In chapter 4 (see section 4.4) the study classified some job characteristics - mainly those related to technological characteristic (performance) and technological characteristic (impact on user) - under the headings of workload, unpredictability, and simultaneity. The factors quantity of work, work pace, change, information overload, and things like too many passwords were classified under workload. Hardware failure, computer crashes, badly designed software, long response times, uncertainty, and disruption were classified under unpredictability. Multi-tasking was classified under simultaneity type of complexity.

### 8.4.3. Workload

Causes in the closed questions of the survey commonly reported as high or medium causes of technostress that were also related to complexity included 'technology problems', 'more demands', 'information overload', 'too much change' and 'security issues' (see section 6.2.2). In the answers to the open-ended questions in the survey also, 11 units coded as 'technological problems' such as fixing errors were also coded as the 'workload' type of complexity. Three units coded as 'time wasting', - for example, preparing technology – were seen as adding workload to teachers, and so were coded as the 'workload' type of complexity. One unit coded as 'pupils' – i.e., teaching students how to use technology – was also coded as the 'workload' type of complexity (see section 6.5.2). Some examples of teachers comments about workload were: "in terms of stress - VERY STRESSFUL - since I end up having to do far more work in my own time than should be necessary"; "it depends, sometimes I am very happy - when my model of educational applications with ICT works, but some time I am stressed when I have a lot of work to do"; "having to put in extra hours in my own time when I should be in bed"; "I am excited about learning new ways to enrich the curriculum using ICT, not spending hours trying to fix network problems" (see section 6.5.2). In the classroom investigation, 13 units coded as 'technological problems', two units coded as 'time wasting', and three units coded as 'pupils' were also coded as the 'workload' type of complexity (see section 7.3.3).

Teachers prepare technology before teaching; sometimes they download and practice the software they are going to use. During teaching, they have to help some students to get access to the software, help them to use the software, and help them to save their work. If there are any errors or faults, they have to spend time to fix them, or wait for someone else to fix them. Less able pupils also put additional demands on teachers. For example, they might ask their teachers to explain basic things about technology. The reasons for this might be because pupils were not adequately trained, but it might be because the technology is not easily understood by pupils. After teaching they have to make sure that the equipment is switched off, and/or they have to make sure that it is ready for the next session; also they have to spend time learning about technology. Some tasks such as switching on/off computers, checking passwords for students in their PCs, and checking IWB and the network could be done by the IT staff in the school. It was recommended by some teachers that everything must be ready for teachers and students before sessions start.

The case studies showed examples of teachers' workload. One teacher argued that because of the difficulty she faced when using technology in her classroom in front of her students, she had to learn about it, and this added load to her (see section 7.4.4). Another said that preparing the technology before her students came to the classroom added to her workload (see section 7.4.1).

Results showed that these added tasks were associated with dissatisfaction. Most of these tasks are compulsory and could not be avoided in technological classrooms. The problem is that these tasks are not related to the teachers' main jobs but are seen by the teachers as interrupting and detracting from the teaching and learning process. Teachers think that such tasks do not end and when they use technology in their teaching, it means they have to do these tasks every time they have classes. Also, they have to continue their learning in order to keep up with the changes of the technology. What makes it difficult for some teachers is that they are alone and have to do it themselves. Sometimes no support is available to help them to do these tasks, different examples were noticed when teachers in their classrooms were in need for technician support from the schools, but there was no response; and they had to solve the problems themselves (this was noticed with six teachers). Additionally teachers are observed by the students, and they have to tell the students how to use the technology and how to learn by using technology (some examples were noticed particularly with primary school teachers). Therefore, none of these tasks could be neglected by teachers or delayed. It is not only the number of the tasks, but it is the difficulty, the continuity, and the importance of the tasks that make teachers dissatisfied and experience technostress.

This group of factors described in this section all relate to adding work, tasks, and responsibilities to the teacher's job, and potentially exceeding their resources; and it is meaningful therefore to bring these factors together under a unifying concept of 'workload'.

### 8.4.4. Unpredictability

The term unpredictability refers to events and outcomes that take unexpected turns. For example one teacher stated that "even though you think you've set it [technology] up to work, it then does something that you're not expecting". Another teacher stated angrily "Goodness me I wasn't expecting half of those things to go wrong" (see sections 6.5.2 and 7.3.3). Some unexpected technological problems are classified to go under the unpredictability type of complexity. In the closed question part of the survey causes commonly reported as high or medium causes of technostress which were also related to unpredictability were unexpected 'technology problems', 'networking problems' and 'uncertainty' (see section 6.2.2). Also in the responses to the open-ended questions in the survey eight units coded as 'technological problems' such as the sudden occurrence of errors were also coded as the 'unpredictability' type of complexity. Example of things teachers said was: "Can't really say other than it happens quite regularly that the computer does not work as it should and it's usually at a crucial time!!" In the classroom investigation, 25 units coded as 'technological problems' such as errors were also coded as the 'unpredictability' type of complexity. Two units coded as 'pupil' for example, errors due to pupils' use of technology were coded as the 'unpredictability' type of complexity. In some situations, teachers were not able to control unexpected errors, and had to seek help from technicians. The case studies showed two examples of this type of complexity, where two teachers reported that unexpected errors and faults of technology sometimes could not be controlled and dealt with (see teacher S 7.4.1 and teacher P 7.4.2).

Teachers could not predict such problems; therefore, they could not plan in advance for the solutions. The uncertainty about the unexpected events and about the proper solutions led them to be unhappy about the use of technology in their classrooms.

Additionally, in some classes students with poor knowledge and poor skills about technology might become involved in unexpected events making some teachers feel cautious about students' use of technology. Also the number of unexpected events might be increased if teachers were not fully confident about the technology they were using. When new technology is first introduced into the school the number of unexpected events may well be high, and will reduce as the technology becomes more familiar.

The important feature of the examples above is that they all relate to unexpected events and tasks; therefore, it is meaningful to bring them together under the unifying concept of 'unpredictability'.

### *8.4.5. Simultaneity*

The third type of complexity was simultaneity - teachers doing more than one task at the same time. Examples of this were found from the classroom investigation; two units coded as 'technological problems', such as doing the narration of the software and writing notes on the board at the same time, were also coded as the 'simultaneity'. Four units coded as 'pupils' – i.e. helping and monitoring less skilled pupils - were also coded as the 'simultaneity' type of complexity. The number of simultaneous tasks or events rises in proportion to the range and complexity of the technology that there is in the classroom (e.g., students' using their laptops might increase the number of simultaneous tasks needing to be carried out); so this simultaneity is an inbuilt feature of technology-rich classrooms. Also students (particularly the less skilled students) play another role in the increase in the number of simultaneous tasks that present themselves for consideration. Moreover, students often are working on different tasks, requiring the teacher to monitor numerous activities at once (see section 4.3). This type of complexity is experienced by teachers fairly unconsciously; but as time goes on, teachers feel tired and become stressed as a result of doing several things at the same time.

In the classroom investigation examples were: "When I have got ... a year nine and there was probably nearly 23 of them and each have a laptop and the thing is I have to go from one child, Miss, Miss, Miss, help me, help. So I helped them. Miss, Miss, help me, so there was no break at all and it was constantly moving and then when I get to the end I have got to start again because the first girl put her hands up again and then they go to Miss you look really stressed and you look really...I said well I am not angry is just is very tiring to go round and do every one's work", "I have got to do five things in the time it takes for one minutes".

These examples show teachers attempting to deal with more than one task at a time; therefore it is meaningful to classify these examples under the heading of 'simultaneity'.

### 8.4.6. Discussion

The relation between the causes of stress and the concept of complexity were illustrated in the introduction to this section (8.4.1) and the ensuing examples given in sections 8.4.3, 8.4.4, and 8.4.5 have shown how these concepts of workload, unpredictability, and simultaneity, all arising from an overarching concept of job complexity can help to provide some structure to thinking about some of the causes of technostress.

The researcher thinks that the concept of the complexity was useful as it, to some extent, describes the nature of the transaction between the individual and the environment. For example, errors might not be a problem, but because they occur sometimes unexpectedly and, therefore, cannot be controlled, so the situation can be described as a form of 'unpredictability'. Similarly, learning is not a problem per se. yet this required the teacher to do more work which is not acceptable by busy teacher; therefore, such transactions can be explained as a form of 'workload'. Moreover, teaching students might not a problem, yet if the situation requires the teacher to do more than one task to teach either the same student or two students in the same time, then this is a problem; and the situation could be explained as a form of 'simultaneity'. Factors such as support could not be put under these three headings as it is not unpredictable, does not add load and, and is not a simultaneous situation. Looking at Tables 65 and 66 shows that of the units coded at nodes associated with job characteristics some 54 units from 128 were NOT also coded as a form of complexity. This included data related to students who ignored their teachers, time wasting factors such as downloading, and some technological problems, such as the performance of the software. The distinctions between these examples of data and those that were coded as forms of complexity are actually quite small, and these examples might actually all be seen as contributing to workload. The distinction is probably therefore more a matter of issues to do with the coding rather than any divisions in the data. It would seem likely therefore that the job characteristics with relevance to technostress can be usefully classified as workload, unpredictability, and simultaneity aspects of complexity.

Some researchers have located the chief cause of stress for teachers in the nature of the classroom environment, sometimes ascribing this to the 'complexity' of the environment (e.g., Doyle, 1979a; see also section 4.3). The classroom environment has been changed by the use of technology, potentially further increasing its complexity, and this in turn can be seen as impacting on stress. The teacher's appraisal of the classroom environment as complex – in terms of workload, unpredictability and simultaneity - seems to lie at the root of much of the stress that was observed, and so complexity becomes a useful unifying term to think about the stressors in the classroom.

## 8.5. Symptoms

### 8.5.1. Introduction

Symptoms refer to the responses made by individuals in reaction to stressors. The research questions related to symptoms were:

*What are the chief symptoms of technostress?*

- *What do teachers report as the consequences of stress experienced whilst using technology in the classroom (symptoms of technostress)?*
- *What are found to be symptoms of stress in the classroom?*

### 8.5.2. Technostress Symptoms in the Literature

Teachers experience a range of psychological, physical, and behavioural symptoms of technostress. Technostress symptoms were much the same as symptoms of other kind of stress. Symptoms of technostress were categorised by Sanderlin (2004) (see section 3.3) amongst others in three categories: physical symptoms, such as increase in heart rate and blood pressure and headaches; behavioural symptoms, such as excessive alcohol intake and smoking; and psychological symptoms, such as depression and frustration. Other symptoms of technostress listed in the literature including the following (see section 3.3):

- physical symptoms: eye and respiratory irritation, weakness, illness, panic, physical problems, visual and musculoskeletal problems, health complaints, headache
- behavioural symptoms: increasing number of errors, repetition, lack of control
- psychological symptoms: memory disturbances, fear, anxiety, feelings of isolation, dissatisfaction, depression, hopelessness, mental fatigue, job boredom, anger, monotony, and frustration.

### 8.5.3. Technostress Symptoms

In this study, examples of physical, psychological and behavioural symptoms were all reported or noticed. In the survey symptoms such as bad temper, mental fatigue, inability to concentrate and anxiety (psychological symptoms); migraine, shortness of breath, lethargy, tiredness, hot flushes, eye strain, back ache, shoulder blades, and raising of blood pressure (physical symptoms); shouting, moaning, and leaving the technology (behaviour symptoms) (see sections 6.4 and 6.5.3). Classroom investigation showed the following symptoms: frustration, irritation, annoyance, anger and anxiety (psychological symptoms); headache, sweaty, feeling hot, and changes in the GSR reading (physical symptoms); shouting and drinking a lot of water during teaching (behavioural symptoms) (see section 7.3.4).

The most commonly observed and reported symptoms in the survey and in the classroom investigation were psychological symptoms. In the survey, bad temper was the most frequently reported reaction (section 6.2.3), and frustration was mentioned by 10 teachers in the response to the open-ended questions (see section 6.5.3). Frustration was the most reported psychological symptom in the classroom investigation (5 teachers, see 7.3.4). The data showed few behavioural symptoms (see sections 6.2.3 and 7.3.4). In the classroom investigation, symptoms were difficult to observe, but they were reported by the interviewees. Changes in the GSR reading (a physical symptom) were measured as part of the study (see section 7.2.2).

The case studies showed a range of symptoms. Teacher P (see section 7.4.2) reported that the inability to deal with unexpected problems of technology that crop up from time to time made her feel frustrated. Teacher ST (see section 7.4.3), reported anxiety as a symptom. Teacher R (see section 7.4.4) reported dry mouth.

The results showed that males and females seem to be sharing almost the same symptoms, and teachers from different kind of schools reported that they shared the same symptoms. There were few significant relationships between background variables and symptoms of technostress. Section 6.4 summarises the main relationships. An interesting relationship here is the association between mental fatigue and technology use for those who use technology relatively little.

In summary, the chief symptoms of technostress noted were bad temper, mental fatigue, headaches, muscle tension, inability to concentrate, anxiety, and frustration. The majority of symptoms experienced were psychological, with relatively few physical and behavioural symptoms. Teachers response to one of the main stressors – 'errors' - tended to be frustration and possibly bad temper.

A number of teachers gave quite powerful descriptions of their symptoms. Teacher R (7.4.4) stated that "Your mouth goes dry, um, you feel butterflies and get hot it's all that sort of thing and sometimes I can even feel the blood pumping round my hands, Yea? It's all those things. It makes you feel uncomfortable, and then you become more sensitive. My goodness you know I'm feeling a bit strange and I hope I'm going to be OK and that makes you feel that bit worse. You worry about that as well". Teacher S (see section 7.4.1) sometimes resorted to shouting and afterwards realised that this is a sign of stress getting to her. Teacher K was very angry and frustrated after teaching one session and stated "It's not a good day for technology today...we should have looked at the stars. Unbelievable! I said that there were going to be stresses in this session because it was less of a routine session for me but, goodness me, I wasn't expecting half of those things to go wrong. And then you are trying to absorb all the stresses of the teachers because you know they are going to say oh you know that happens at school and it's the one reason why they don't want to use technology. And now you're trying to say it's not stressful at all" (see section 7.3.4).

## 8.6. Coping

### 8.6.1. Introduction

The third element of the process of stress is coping - seen as the strategies used to deal with stress - and the research questions related to this were:

*What are the coping strategies that teachers use to deal with technostress?*

- *What are the strategies they use to deal with this stress (coping strategies for technostress)?*
- *What are found to be coping strategies used in the classroom?*

### 8.6.2. Technostress Coping Strategies in the Literature

Coping strategies are commonly classified as either emotion-focused strategies or problem-focused strategies (see 2.4.3). An emotion-focused strategy is an attempt to deal with the emotional disturbance resulting from stressors. A problem-focused strategy is an attempt to change the features of the environment, especially those which cause stress to individuals. A number of studies have discussed 'coping with technostress'. Emotion-focused strategies include such things as the 'relax or socialize solution', providing psychotherapists, and changing attitudes towards technology. Problem-focused strategies include such things as training, communication, technical support, practice, reinforcement, appropriate funds for upgrade and repair, and increase knowledge and skills by asking for help (see section 2.4.3).

### *8.6.3. Technostress Coping Strategies*

The data provided examples of both kinds of strategies in the responses to the open-ended questions and in the classroom investigation.

Emotion-focused strategies, such as drinking too much alcohol, getting used to problems, blaming oneself, avoiding future use of technology, leaving the profession were reported in the survey. None of the ways of coping cited above was mentioned in the interviews. In the survey, problem-focused strategies mentioned included seeking help from technicians, dealing with the problem, and/or training, (see section 6.5.4). The same factors were noticed in the observations and reported by the interviewees in the classroom investigation (see section 7.3.5).

In the case studies both types of strategies were observed or reported. Teacher S (7.4.1) reported some emotion-focused strategies, such as exercising and playing sports; she also reported problem focussed strategies, such as; fixing the errors or asking others for help. Another example of a problem focused strategy was reported by teacher P who stated that she would not submit to the problems and would struggle to solve them (see teacher P 7.4.2).

In the classroom investigation, problem-focused strategies were reported by seven teachers, and emotion-focused strategies were reported by five teachers. In the survey, 65 units were classified as showing problem-focused strategies and 40 units classified as showing emotion-focused strategies. Both sets of data suggest that problem-focused strategies are more frequently reported than emotion-focused strategies. This may be taken as a positive sign as an indication that technostress was seen as a problem that could be effectively responded to (see section 2.4.3)

In summary, both problem-focused and emotion-focused strategies were found in response to technostress, and the strategies seen were much in line with those described in the literature. Problem-focused strategies were somewhat more common, which may be a sign that the stress can be appropriately responded to in many cases. However emotion-focused strategies were often recorded, which indicates that there are underlying problems that need to be addressed. Possibly of some significance is that respondents were more likely to admit to emotion-focused coping strategies in the anonymous context of the survey rather than in interviews.

## 8.7. The T-TE model

### 8.7.1. Introduction

The study had anticipated that the causes of technostress would not operate as independent cause factors, but that their influence would be mediated by the personal understandings of the teacher. One of the research questions was therefore:

> *What is the nature of the relationship between technology use and technostress? Is this a relationship mediated by the personal understandings of the teacher, and if so in what ways?*

### 8.7.2. The relationship between the use of technology and technostress

Stress in the literature has been explained by physiological approaches which focus on a discussion of the physiological changes of the person when responding to stressors; by environmental approaches which focus on the external environmental demands upon the person; and by psychological approaches which focus on the interaction between the person and the environment. The transactional approach to stress (Lazarus, 1966; Lazarus and Folkman, 1984), which emerged from the psychological approach to stress, proposed an explanation based on the relationship between the individual and the environment (in this study the teacher and the technological environment). It has been argued by a number of researchers that this approach provides the clearest explanation of the subjective stress process (see for example Cooper, et al., 2001). This transaction depends on the impact of the stressor, and it is mediated through the appraisals process and the coping process (see section 2.2.3.2). In the literature, some researchers have argued for the importance of individual variables and environmental variables in this approach. Environmental variables include such things as demands and opportunities, and individual variables include such things as goals, beliefs about self and world, and personal resources (see Lazarus, 1966).

The P-E fit model (French, et al., 1982; Caplan and Harrison, 1993; Edwards, et al., 1998) is one of the models arising from the psychological approach that investigates the relationship between the person and the environment, and which sees the stress as a result of lack of fit (see section 2.3.2). This model has been used widely in studies of stress in the workplace and in the classroom. It is "based on the assumption that people vary in their needs, abilities just as jobs vary in their incentives and demands. When there is a poor fit between the characteristics of the person and related characteristics of the job, P-E fit model predicts that employee['s] wellbeing will be reduced" (French, et al., 1982, p. 27).

The relation between these two variables (technostress and the use of technology) was not so clear when the data of the survey was analyzed, but there were some variables, which influence to some extents the relationship. These variables were related to teacher's characteristics – particularly age, attitude, and time of use.

Four cases studies clarified to some extent the nature of the relation between the technostress and the use of technology. These case studies showed clearly some teachers with different characteristics experienced technostress to different degrees. It was shown that teachers with positive attitude and use technology a lot do experience technostress less than those with negative attitude and use technology less in time. In the case studies, an example was in the case of teacher R who explained her feeling about a threat she expected from the technological environment 'Thing goes wrong' this situation was an example of 'primary appraisal'; also she explained her beliefs about her skills as not "the most computer literate", and that led her to think that she wouldn't be able to cope with it, this was an example of 'secondary appraisal', and thus expecting experiencing stress (see section 7.4.4). Another example of teacher with positive attitude, used technology a lot, reported that she did not experience high technostress, she stated that "This was not a very stressful lesson was it? ... Yes if it was Friday afternoon with class year eleven I think you will probably go up your scale haah, because this to me I felt like a holiday lesson because the computer was doing all the work, I felt that I was not doing anything". Teacher P explanation stated that the computer did all the work she needed in this class; therefore, she felt no stress and the lesson was just like a 'holiday' as she had expressed (see 7.4.2). The account of the appraisals, the symptoms, and the coping strategies used by teacher (e.g. in the case study of teacher R 7.4.4) illustrated the transaction between the teacher and their technological environment. These two examples showed that the effect of technostressors is mediated by the teachers' appraisal-process and coping-process. The case studies showed that some teacher experienced technostress, whereas others - although there were problems with technology - did not experience technostress, e.g., teacher S (7.4.1) sometimes considers technological errors as a challenge for her and works hard to solve them or asks for help. Some other teachers - although there were no problems with technology - thought that they were not able to use technology and thus they did experience technostress e.g. was clear in the case of teacher R (7.4.4), who holds negative attitude towards technology, does not used it a lot, and views using technology as stressful work. This provides support for the view that the relationship between the use of the technology and technostress is mediated by the teachers' perceptions.

Examples from the case studies illustrate how this process works:

- For teacher R when 'Thing goes wrong' in her classroom, it was judged as a threat (primary appraisal); she also assessed her skills as not "the most computer literate", and that led her to think that she wouldn't be able to cope with it (secondary appraisal); this causes stress, and she prepares to cope by asking for support from the school (see 7.4.4).
- Teacher S faced different problems with technology one was when the printer did not work, so the situation was judged as a problem: "Yes ... that was stressful because I didn't know ... that we couldn't print" (primary appraisal), but her assessment about herself, "I would try and think of how we could work around it, and I think I can do that because I know the system here" (secondary appraisal) resulted in a perception of "it's kind of irritating and annoying", a feeling of stress,

and this led her attempt to cope by looking for solutions for the problem (see sections 7.2.3 and 7.4.3)

- Teacher S faced a problem with the voting device "That active vote thing, I don't know why that doesn't work; last week it was working; today it doesn't work, I have no idea why" she acknowledged the problem and did not know why it did not work (primary appraisal); she said "It is frustrating, and then a little bit of stress comes with that because your thinking – you know – it is not working – I can't do what I planned" (secondary appraisal), and she admitted that she won't be able to make it worked and this caused her to get frustrated.

So, it would seem that the relationship between the teacher's judgment about the situation (primary appraisal) and the evaluations of oneself (secondary appraisal) determines the nature of the transaction between the teachers and their environments and it is this which determines whether the situation is experienced as stressful, and hence gives rise to symptoms of stress and coping behaviours.

### *8.7.3. The adequacy of the T-TE model*

The study has proposed a specific model of how this relationship between the use of technology and technostress might work, which was called the T-TE model, so the last research question was:

*Does the T-TE model provide an adequate model of this interaction?*

The following discussion will be concentrated almost exclusively on the central element of the model, which is the explanation of 'cause' in terms of T-TE fit, and will largely ignore the elements related, for example, to 'coping'.

The T-TE model proposes that the interaction between the teachers' understandings (T) and the technological environment (TE) can be expressed in terms of 'fit' between T and TE, and in particular it conceptualises this fit as a Demand-Ability fit or a Need-Supply fit.

The model distinguishes between objective and subjective variables, but in practice it was usually difficult in the study to make this distinction in a meaningful way, and so this distinction will not be discussed further.

Table 67 below shows examples of how the experience of some of the teachers in the study can be expressed in terms of the two forms of the T-TE model and indicates whether technostress was exhibited. Examples in the table show examples of the lack of fit between a demand to fix errors and the inability to fix them, the need for training and the lack of provided training, using software which is difficult to use and the inability to use it, workload added by the demands of working with students with low level technology skills and the inability to deal with the added work, and the need for technical support and the delay in providing technical support.

| Demand-Ability & Need Supply forms | | | Causes | | Symptoms<br>Physical symptoms<br>Psychological symptoms<br>Behavioural symptoms | Coping<br>Problem-focused coping<br>Emotion-focused coping | Technostress exhibited |
|---|---|---|---|---|---|---|---|
| | | | Technological problems, time wasting, lack of support pupils' use of technology | Teachers | | | |
| | | | **Environment (Demand or Supply)** | **Person (Ability or Need)** | | | |
| Degree of fit | Fit | D-A form | ICT skills required (Teachers S, K, and P) | ICT abilities and skills acquired through training | None | None | No |
| | | N-S form | Technical support supplied (Teachers S, K, and D) | Need for technical support | None | None | No |
| | | | | | | | |
| | Lack of Fit | D-A form | Errors to be fixed (Teachers P, H and K) | Inability to fix errors<br>Inability to deal with increased workload | Frustration, annoyance, flushed face, headaches, sweating, change of breathing, heart rate increase, dry mouth, got hot, anxiety | Try to fix the error.<br>Seek technical support | Yes |
| | | D-A form | Equipment must be fixed (Teacher S) | Inability to deal with increased workload | Annoyance, tiredness | Prepare ICT before session started | Yes |
| | | D-A form | Explain the use of the software to pupils (Teachers E, and D) | Inability to deal with increased workload | Nervous | Exercise and practice for learners | Yes |
| | | D-A form | Pupils' expectations (Teacher R) | Inability to deal with increased responsibility | Frightened | Get used to level of expectation! | Yes |
| | | D-A form | Software hard to use (Teacher R) | Not able to use software effectively | Feeling uncomfortable | Change the software | Yes |
| | | N-S form | No, or delayed, technical support (Teacher ST) | Need for technical support | Frustration | Seek additional technical help | Yes |
| | | N-S form | Poor, or no, training supplied (Teacher R) | Need for training | Disappointment | Seek training | Yes |

**Table 67: The two forms of the T-TE model and the technostress**

Clearly there are many interactions between teachers and technology that do not give rise to stress, and the data from the classroom study coded at the 'no technostress' node (see 7.3.6) gives examples of teachers' interactions with the technological environment where this was the case. An example (see 7.4.5) is teacher P, who said, "This was not a very stressful lesson was it? Yes if it was Friday afternoon with class year eleven I think you will probably go up your scale, haah. Because this to me I felt like a holiday lesson because the computer was doing all the work. I felt that I was not doing anything". She argued that the computer did all the work (TE - supply) she needed (T - need) in her class, so there was a fit between her need and the supply from the environment; therefore, she felt no stress.

In order to see how well the model describes the various causes of stress, the researcher will start from the groups of causes that he identified in the literature:

1. Job characteristics
    a) Social characteristic
    b) Technological characteristic (Performance)
    c) Technological characteristic (Impact on user)
2. Organisational characteristics
3. Personal characteristics

**Job Characteristics**

Social characteristics were not looked at in this study, and play no place in the model. As for the Technological characteristic (Performance) and Technological characteristic (Impact on user), in the survey it was found that the teachers agreed that all the suggested factors were causes – though some were rated as higher causes of stress than others, and it was shown in 8.4.1 how these might be classified according to the categories of complexity identified in Chapter 4 (unpredictability, workload, and simultaneity). These three forms of complexity are all aspects of the technological environment, making specific kinds of demands on the skills of the teacher, and so differing abilities in dealing with these demands will explain the existence (or not) of stress.

In the analysis of the answers to the open-ended questions and the classroom investigation, the categories 'technological problems', 'time wasting', and 'pupils' use of technology' were used:

- 'Technological problems' refers to a specific kind of demand calling on particular abilities.
- 'Time wasting' is not in itself a demand, though teachers clearly recognised time wasting as a specific aspect of their difficulties with technology, it contributes to workload, and so it is this that constitutes a demand and hence requires the corresponding ability to deal with this workload demand.
- 'Pupil use' is again not a clear demand in itself, but it does increase workload, creates a specific new workload (i.e. answering the questions), and results in situations with many simultaneous demands, and it is these characteristic of the technological environment that constitute demands and require corresponding abilities.

**Organisational characteristics**

In the survey, there was the cause of 'New learning required', and in the analysis of the open-ended questions and classroom investigation the researcher coded data at two nodes associated with organisational characteristics which were labelled as 'Lack of support', and 'Teachers'.

The cause 'New learning required' relates closely to the data coded at the node 'Teachers' – essentially relating to the abilities of teachers. This study therefore has two main elements under this heading:

'Lack of support', which relates to a need for support, and the two constitute a Supply-Need fit/misfit

'Teachers' (that is, 'Abilities of teachers') which relates to a demand for skills which is related to a Demand-Ability fit/misfit

**Personal characteristics**

The personal characteristics looked at in the study included age, gender, school taught at, attitude to technology, and amount of use. The characteristics of gender, and school taught at had no relationship with stress and are not part of the model.

Age was associated with indications of increased stress, but it is likely that it did not have a direct impact on technostress itself, but rather increased age was associated with more negative attitudes to technology and less use of technology, and it was this that led to more technostress.

The variable of attitude can be regarded as an element of the Teacher characteristics in the model that would interact with the TE variables. The variable of amount of use does not have a direct role in the model, though it might be interpreted as a reflection of attitude, confidence, and skill in use of technology, all of which could be seen as Teacher characteristics.

**Conclusion**

A consideration of these various forms of causes and the evidence related to them in this study, therefore, provides support to the view that the T-TE model can provide an adequate representation of the main factors involved in technostress in the classroom.

**Examples from the classroom investigation:**

To complete this section a number of examples will be given from the classroom investigation where the operation of the factors of the T-TE model can be reasonably clearly seen. For example, a teacher stated that "It then does something that you're not expecting ... You know how pleased I was when something works for me this morning and I thought yes that is easy that bit will run smoothly and that was the bit that I expected to have a problem so I checked it and it worked and when they came to do it, it didn't work. And they couldn't hear any sound from the web-site. I was listening to all those sounds last night when I was preparing it anyway ... you can expect something to happen but it's the way it happens. You can prepare for things to go wrong in a certain way but if they go wrong in another way that you haven't even thought of or not expecting because you've tested and know that it works in the way you have just done then that's stressful because your way out isn't clear any more. Your strategy for getting round it has been foiled and something is coming up against you and ... whoops ... no ... you can't do that". This is an example of Demand (to correct the errors) and lack of Ability. This example illustrates the specific nature of the relationship between the particular demands of the environment, presented as errors which needed to be corrected, and the specific abilities of the teacher. She was able to deal with a range of similar problems, but this specific problem was beyond her abilities, and this very fact that she could have solved very similar problems, but not this one seemed to actually increase her frustration. Another teacher stated that "And then you've got the technology on top which as a new convert to technology, I'm still learning so very sort of inexperienced and unsure about technology so there's the two things working together and so when things go wrong and you have an audience my goodness you know this is not what I really want to happen. And it is really very stressful". This is an example of an organisational Demand (to use technology and to correct errors) and lack of Ability on the part of the teacher due to inexperience and lack of knowledge. An example of Demand (to use new software) and lack of Ability on the part of the teacher to use it was found in this statement "Yah I do but sometimes I am nervous when I am using for the first time. Before on the whiteboard I use the PowerPoint but then I started using an active studio program which I was nervous about doing". Another example of the teacher's Need for consistent technological environment and the lack of Supply, was "Because I am in like four or five different rooms and the whiteboards are inconsistent and I don't always get the same things coming up ... or ... in ... network system ... there was a couple of files which I can access in other rooms but cannot access in this room". An example of the teacher's Need for appropriate technology and the lack of Supply could be "I cannot stand the fact of not knowing if the computer is going to work or no and that is a nightmare.", Also another example of the teacher's Need for support and the lack of Supply of this support could be "I got this software which I said it is so good I have had two years it is not on the network all that time I have not been able to use it because I have to wait for an IT technician to install it, you have really want to use software to push for it to be installed in the network"

**The following two sections will highlight the main contributions and the limitations of this study.**

## 8.8. Contributions of the study

This study has made contributions to the knowledge about technostress in the workplace, has advanced the understanding of associated theory, and has advanced knowledge about possible and appropriate methods for data capture.

**Contribution to knowledge – the empirical contribution:**

The survey enables us to get an overall picture of place of technostress in lives of teachers – providing an account of the major causes, symptoms, and coping strategies. This enables us to provide an account of technostress as an additional stress in the classroom, brought about by technology. It could be considered as a side-effect of the integration of technology in the classroom. Age, attitude towards technology, and time of use were shown to have a strong relationship to some causes of technostress whereas gender and kind of school showed no relationship.

The classroom investigation enables a more detailed account to be developed, presenting a detailed description of teachers' feelings about the use of technology, the difficulties it presents, and the ways teachers dealt with these difficulties in the context of technology supported teaching sessions. This enables the creation of a picture of technostress in the classroom, providing a description of the transaction between the teachers and the technological environment, and their feelings about technostress.

The study also enables a description of some of the stressors associated with technostress in terms of job complexity.

The reported and the observed problem-focused coping strategies are evidence in this study of the possibility of coping with technostress. This study therefore suggests that although technostress exists in classrooms, it is possible for teachers and schools to deal with it.

There is no similar description of the technology-related stress in classrooms prior to this research, and so this presents a contribution to the knowledge in this area.

### Contribution to theory - the T-TE model

The development of the model integrates the transactional theory with an overview perspective on stress and with a consideration of technological environment. This model provides a useful perspective from which to discuss stress associated with the use of technology in the classroom. The 'Teacher-Technology Environment Interaction Model of classroom technostress' highlight the processes of teacher stress in a technological environment, and highlights the transactional nature of the process, identifying the two forms of lack of fit as the source of stress.

A second conceptual contribution was the identification of complexity as a useful organising concept for identifying and thinking about many of the characteristics of the job that teachers were doing and how this might then relate to stress. The three aspects of complexity that had the most relevance were workload, unpredictability and simultaneity, which relate to the teachers understanding of the work demands and, therefore, enter the T-TE model as an aspect of the Subjective Technology Environment.

### Contribution to methodology

The basic methodologies of this study: the combination of a survey followed by classroom investigation and the use of a classroom investigation involving multiple methods of data collection were successful, but not new in any way.

Two aspects of the methodology, however, do present novel features:

- This study showed the possibility of using the wireless GSR in classroom studies, equipment was selected to ensure that necessary measurements and observations could be made with minimal interference with classroom activities, and this method crucially was able to gain teachers' acceptance.
- The GSR output and the video were used as a basis for certain aspects of the interview, acting as prompts for eliciting teachers' thoughts about what was happening at possible moments of stress in the classroom.

## 8.9. Limitations of the study

In hindsight the study should perhaps have put more emphasis on examining the nature of technostress and how it manifests itself, and perhaps less emphasis on establishing the mere existence of the technostress. More emphasis could have been given to asking about the interactions between the teacher and the technological environment.

This section will discuss issues related to the sample, the methods, and the analysis of the data that could also have been improved on.

**The Survey**

Sampling in the survey was opportunistic, so the researcher does not know how representative it is of the teaching body. A more representative sample could have been obtained by structured random sampling of teachers, but this is a time consuming process beyond the resources available in this study.

The survey may have been too long. Some subscales were too long and it would have been better to select some questions that would have covered what was needed from the subscales. Some sections of the questionnaire were not actually used in the analysis and could have been omitted - for example, the list of types of technology used by the teachers. Also the subscales about physical and psychological health may not have been a useful screening device. The researcher did not see any major change when he analysed the data related to these subscales which indicates it might be possible to carry out the study without including them.

The survey could have had a better mapping onto theoretical classifications derived from the literature. Maybe because the study was focusing on the stress in the classroom, it did not consider some other causes of stress that might have resulted from the school environment in general. Also the survey might have been able to explore more issues to do with 'fit'. The focus was on providing evidence about the existence of the technostress, so to some extent it missed the aim of providing the explanation of the fit between the teacher and the technological environment.

More trialling would have helped to refine the questions, which would have given a better view of what was going on. The pilot studies were conducted outside schools, and some of the participants were teachers studying in the university, so they might well not have been representative of the general population of teachers.

## The Classroom Investigation

### Sampling

The researcher did not realise when he started how much work was needed, and therefore, he overestimated what could be done. The study used different methods, and was difficult to be conducted. Also, the time of this study was very limited. The access to the participants was difficult and the size of the sample was relatively small due to the limited number of volunteers. It was a significant challenge to find a volunteer who would accept being 'wired up' to the GSR while teaching in the classroom in front of his/her students, and then to be observed at the same time by the researcher while using technology for teaching. Additionally, it was hard to seek their acceptance for recording his/her level of stress. It was not an easy task to convince the schools, the head teachers and the teachers themselves to allow us to conduct the study at their premises. Also, persuading them to accept the use of a video camera in the classroom was a difficult mission too. Furthermore, it was not easy to find a teacher who extensively uses technology for teaching. Some teachers do not use technology in their classrooms at all, whereas the use of technology for others was limited to simple technology, such as a data projector and a presentation program.

### Data collection

The difficulty of real-world research settings became apparent in this study because it was important to observe, write comments, and at the same time record the reading of the GSR. The researcher thinks that because he used three methods, he probably missed the benefit of each method, and so two methods or less could have been better if they were used in an adequate way.

Using in-depth classroom observations was enough with videotaping, and could have fulfilled the objectives of this study without even using the GSR. In this study the use of GSR actually did not tell us a lot that was useful (though the researcher believes that it could do so and that he has at least established the viability of collecting such data). Sometimes it corresponded to stress, but the researcher could not see it as an indicator of stress. Also there were some 'functional problems' with the GSR unit. There was uncertainty about the causes of the stress in some situations, sometimes the GSR gives high reading due to other factors not originating from the technology, as reported in some interviewees. Alternative methods, such as the use of a Blood Volume Pulse (BVP) monitor, might have been more effective.

The time needed after the class to interview the teacher was not always possible. Some interviews lasted only fifteen minutes, which was not enough to cover the events in the classroom. Also interview schedules should have been more structured in order to address the issues the researcher was interested in.

**Analysis**

Maybe because the researcher has concentrated more on demonstrating the existence of technostress in classrooms, the research design was appropriate for capturing certain kinds of data, but was not that appropriate to capture the detail that would be needed to more adequately describe the processes of technostress. The data particularly the survey data, did not give clear picture of developing incidents across the time. The classroom observation, to some extent, captured data about the incidents, but the main form of analysis reduced this to a set of categories which broke up the unity of the incidents, though the case studies did help to complete the picture in terms of descriptions of incidents to some degree.

**Mitigating the limitations**

The use of two kinds of study, the survey and the classroom investigation, and the use of three forms of data collection within the classroom investigation mitigated the limitations of the use of each approach independently. Some limitations of the survey, such as the length of the survey; the lack of investigation of the 'fit' between the teacher and the technological environment; and conducting the pilot studies outside classroom environment were mitigated by the use of the classroom investigation, which provided data in a more realistic context. In the classroom investigation, the use of the three methods provided a variety of kinds of data, which could be checked against one another. The use of the observation and the interview methods overcame the limitations of the GSR.

# Chapter Nine

## RECOMMENDATIONS AND CONCLUSIONS

### *9.1. Introduction*

The study's main research questions concerned the existence of a relationship between technology use and teacher stress, the key factors that influence teachers' stress in a technology-rich classroom environment, and the nature of any relationship between technology use and teacher stress in the technology-rich classroom (see section 5.3).

The causes, symptoms, and coping behaviour reported in the study provide evidence that suggests that teachers are well aware of technostress. Teachers who participated in this study perceived certain technological issues as threatening and often argued that their limited resources, abilities, and skills were not capable of stopping, or even mitigating, the affects of these factors. However, some teachers were less sure about the existence of technostress. One teacher in an interview said that the experience of using technology in the classroom was just like any other stress; there was nothing special about it; and another teacher was happy to talk about it in terms of 'anxiety', but not as stress. The majority of the evidence, however, points to technostress as a significant issue in the lives of many teachers using technology in the classroom.

Technostress tended to be associated with age, negative attitudes towards technology and less use of technology in teaching. The variables age, attitude, and amount of use of technology influenced the reported causes of technostress, indicating that older teachers, teachers who hold negative attitudes, and those who use technology less do experience more stress. This present study found no relationship between technostress and gender or the kind of school where the teacher taught. Age alone was probably not a crucial factor, but was correlated with attitude to technology and the amount of use of technology, both of which were important factors. Those who use technology for longer were found to be less likely to report a number of causes of technostress as 'high'. Some evidences were found that poor skills can cause stress –

the main evidence for this being in the expressed desire for training and the argument expressed by teachers that inadequate training contributed to stress.

The main factors associated with technostress were classified in the literature as

1. Job characteristics
    a) Social characteristic
    b) Technological characteristic (Performance)
    c) Technological characteristic (Impact on user)
2. Organisational factors
3. Personal characteristics

The study did not look at the social characteristics as a sub-set of job characteristics. The other job characteristics included such things as technological problems (e.g., errors, networking problems, badly design software, more demands, preparation, uncertainty, and information overload); time wasting; and pupils' use of technology. The job characteristics could be interpreted in terms of types of job complexity in the technological classroom environment. The concept of the complexity was useful, and the types of complexity workload, unpredictability and simultaneity were found to represent the job characteristics associated with technostress. Workload was related to the work added by the use of technology, such as preparing the technology for the class, downloading and practicing the features of the software, helping students use the software, saving students' work, solving problems, and spending time learning about the technology; unpredictability was related to the unexpected errors and faults that teachers were unable to control; and simultaneity was related to contexts where the teacher was required to deal with more than one task at a time, which is often an inherent feature of technology-rich classrooms.

Organisational factors included lack of support; and lack of provision of training for teachers in the use of technology.

Personal characteristics included attitude to technology and amount of use of technology.

The chief symptoms of technostress noted were bad temper, mental fatigue, headaches, muscle tension, inability to concentrate, anxiety, and frustration. The majority of symptoms experienced were psychological, with relatively few physical or behavioural symptoms.

The participating teachers used different ways of coping with technostress. Problem-focused strategies were more common, which may be a sign that the stress can be appropriately responded to in many cases. Problem-focused strategies included seeking help from technicians, trying to solve the problem, seeking training, and/or changing plans. Emotion-focused strategies recorded included drinking too much alcohol, resigning oneself to the fact that problems will occur, self-blaming, and avoiding future use of technology. Respondents were more likely to admit to emotion-focused coping strategies in the anonymous context of the survey rather than in interviews.

The cause of technostress was conceptualised in this study in terms of a lack of fit between the environmental characteristics and the individual's characteristics. The relationship between the environment and the teacher's judgments about the situation (primary appraisal) and the teacher's evaluations of him/her self (secondary appraisal) determines the nature of the transaction between the teachers and their environment and it is this which determines whether the situation is experienced as stressful, and hence gives rise to symptoms of stress and to coping behaviours.

The T-TE model proposes that the interaction between the teachers' characteristics (T) and the characteristics of the technological environment (TE) can be expressed in terms of 'fit' between T and TE; and in particular, it conceptualises this fit as a Demand-Ability fit or a Need-Supply fit. A consideration of the various forms of causes, and the evidence related to them in this study, provided support for the view that the T-TE model can provide an adequate representation of the main factors involved in technostress in the classroom.

Having briefly highlighted the main results of the study, the following section discusses implications and recommendations.

## 9.2. Implications and recommendations for reducing technostress

This study demonstrates that technostress exists in technological classroom environments; and therefore, teachers and their managers need to be aware of this. Since the symptoms are mainly psychological and occur for short periods, it can be deduced that the stress is not critical for most teachers and we therefore have an opportunity to solve these problems.

The lack of fit between teachers and the technological environment is the cause of stress in our model, so technostress can be reduced by improving the Demand-Ability fit and the Need-Supply fit.

### 9.2.1. Demand-Ability fit

Demands refer to work demands arising from the use of the technology in the classroom. Abilities refer to the teacher's ability to meet the demands of the work situation, (including skills to teach using technology and the ability to prepare, install technology, and monitor students' use of technology). The main demands come from the job characteristics, which have been shown to be types of complexity – workload, unpredictability, and simultaneity.

**Workload**

The increased workload associated with the use of technology has a number of sources, and will look at the major ones below.

Some technology is just not easy to use, and needs to be improved. Buzhardt and Heitzman-Powell (2005) argued that "an infinite amount of training and improvement to schools' ability to implement change will do little to overcome the poor usability of a software application or website" (p. 14). They suggested that "educators should take a stronger interest in learning about the usability of the technology they purchase" (p. 15), and concluded that "improving the usability of educational technology will not miraculously solve all of the difficulties associated with integrating technology into schools, but it is a piece of the puzzle that rarely receives attention by the educational community" (p. 26). So the demands of the technological environment can be reduced by making the technology easier to use. Alternatively or additionally, teachers can improve their ability to deal with these demands by acquiring better technical skills. Some teachers stated that training helped them adapt to technology in their classrooms, whereas others complained that they had been asked to use technology without appropriate training (some examples were provided in 8.3). Teachers need to develop both their skills and their confidence in using those skills (as stress is influenced by the perception of the individual about his/her skills and abilities to cope with his/her environment - see Kyriacou 2000, 2001).

In other work contexts, researchers have argued that "failing to provide employees with appropriate technological training results in work-related stress, increased anxiety, increased error rates, frustration, and employee alienation" (see, Sanderlin, 2004). It is also important to stay current with developments in new technology. Teachers need regular and continuous retraining and skill enhancement to keep pace with the acceleration of educational technology (see, Zhao and Bryant, 2006).

The experience of workload can be reduced (and hence stress reduced) by the development of appropriate pedagogical skills in the use of technology. Technology brings about new expectations of what is needed in the classroom, and teachers are not sometimes sufficiently well prepared. Techniques such as encouraging collaborative work and developing learner autonomy can reduce the demands on teachers, and developing work around the construction of artefacts which allows for differentiation by ICT skill levels, and subject skill levels can also reduce the demands of the technological classroom.

Some of the workload stress is caused by increased demands of students who may not appear to have the necessary skills to use the technology appropriately. A number of teachers in the study pointed to this as a specific issue. It might be that this workload could be reduced by increased training of pupils in ICT skills, or it may be that the development of pedagogical techniques enabling pupils to develop both sets of skills at the same time within the classroom would be an effective way forward.

**Unpredictability**

The unpredictability of hardware and networks was one of the major causes of stress. Clearly an improvement in the stability of hardware and networks would reduce this source of stress, as would improved understanding on the part of teachers of the working of networks – for not all 'network problems' turned out to be real problems, some of them are due to misinterpretations by the teachers.

Teacher can reduce the impact of unpredictable technologies by:

- slowing down (Clute, 1998, p. 32);
- using a variety of technological approaches, so that if one did not work, another may still work;
- having a back-up plan with a low-technical activity involving pen and paper;
- brainstorming with their students on constructive ways of dealing with the technical problems they encounter, so if it is a simple thing, they could possibly fix it themselves.

In order to help them cope better in case of unexpected classroom events teachers might console themselves by:

- remembering that the technology failure doesn't make them any less professional or any less good at teaching, sometimes technology, just doesn't work;
- remembering that making mistakes is part of the learning process.

**Simultaneity**

The simultaneous demands of many processes and the demands of many students at the same time can, to some degree, be reduced by appropriate classroom management:

- using collaborative e-learning, which will reduce the number of concurrent events, enabling students to learn from each other so the more skilled students could help less skilled students.

Teachers can also cope better with the remaining demands, by better management:

- concentrate on the main goal;
- ignore unimportant and obstructive events;

- know that some issues could be dealt with later;
- decide when to switch between tasks;
- be aware that task switching might cause poor performance;
- accept that they can only deal with one task at a time;
- accept that some students demanding attention will have to wait because they can only deal with one at a time.

### 9.2.2. Need-Supply fit

'Needs' refers to the needs that the teacher has in order to be able to function appropriately in the classroom. Supply refers to the resources, such as reliable technology, social support, provision of help and appropriate training, and technical support to solve technical problems.

There was a need for technical support to help teachers cope with errors. The technicians' role is to provide technical support for teachers, and maintaining the technology in their schools, and fixing errors. It was reported that sometimes technicians in schools could not respond to all requirements of the staff. Some teachers felt that the need was sometimes not adequately met by the supply of such support. There was some evidence that some teachers may not be able to effectively manage this relationship with technicians, complaining that software was not installed for them, or that help was not forthcoming. It maybe that some teachers need help in accessing the supplies to meet their needs.

A more general need for social support has been emphasised by a number of studies; some reported that it improves psychological wellbeing in the workplace (see, Bullinger and Ziegler, 1999). It is argued that support by schools' administrators has an effect on teachers' attitudes towards computers and may lead to less computer anxiety (see, Kian-Sam and Chee-Kiat 2002). Schools could provide social support by offering advice and assistance to teachers regarding stress and coping programmes. Schools as well as organizations "can also alleviate work stress by providing appraisal, informational, instrumental and emotional support ... Appraisal involves expressing respect, support, and encouragement to employees [teachers]. Emotional support offers a sense of trust and care by allowing employees [teachers] to discuss problems and solutions, while information and instrumental support include advice and referrals" (Sharif, 2000, p. 111). Providing a healthy working environment for teaching may help increase job satisfaction. School administrators should "look at the environment in the school in order to create a healthy climate to help reduce the likelihood of stress" (Al-Mohannadi, 2004, p. 267). This would also encourage them to do their work in an organisation that provides a safe and healthy working environment. Sanderlin (2004) stated that "psychotherapy can assist technology workers experiencing technostress to think differently about technology".

## 9.3. Future research

The study has suggested the following future studies arising from this work:

Due to the increased use, and pace of technology adoption in the classroom, is techno-stress is increasing or decreasing? Does technostress reduces as teachers become habituated to using the technology? Also, do those who experience technostress over a long period of time cease to use the technology?

Different coping programmes have been used to overcome stress and complexity in workplace, including training and developing employee skills. Do these training programmes based on the principles outlined above (a) reduce perception of job complexity and (b) reduce stress? Also, can teachers learn effective coping strategies from the examples of other teachers?

What kind of preparation do pupils need in order to be able to make effective use of ICT for learning? And, finally, are use of GSR and blood pressure monitor useful in determining the experience of stress, and so in developing further studies in stress in the classroom?

It is possible that some teachers experience a complex of stress factors, and that this may connect with more general personality factors, and hence impact on an individual teacher's willingness to use ICT. This possibility was not pursued in the analysis of the data in this study, and such an analysis would constitute a useful follow up study.

## 9.4. Conclusions[10]

The study has demonstrated the existence of technostress when teachers use technology in the classroom. This arises from lack of fit between the teacher and the technological environment between the demands of the technological environment (preparing technology, fixing errors) and teachers' abilities (skills), and between teachers' needs (adequate technology, training, and support) and supply (training, and technicians). This lack of fit results in the manifestation of a range of symptoms of stress and of coping behaviours, and have been summed this up in the Teacher-Technology Environment Interaction Model (which is a representation of the P-E fit model and the transactional model of stress within the context of the technology using classroom).

The present study is small in scale, and as a consequence the conclusions drawn can only be tentative; however, these conclusions do enable the generation of hypotheses which could now usefully be tested in larger-scale studies. Some of the causes of lack of fit were related to certain complexity types, a major finding of this study. Technology increases tasks and events in the classroom and imposes additional workload upon teachers. Additionally, unexpected events and outcomes were increased in the presence of technology due, for example, to failures and errors encountered by less able, unskilled, or under-trained teachers. Moreover, dealing with more than one task at the same time was reported by some teachers when they use technology.

The majority of symptoms exhibited by teachers in this study were psychological in nature rather than physical or behavioural, and so the stress can perhaps be described as not 'critical', in the sense that things are not beyond repair and that it should be possible to devise appropriate strategies to manage this stress.

The acknowledgement of the existence of technostress is an important step in beginning to cope with the problem. The use of the model described here enables managers to identify possible environmental factors that may need to be changed to

10 The text of these conclusions relies heavily on the discussion of this work already published in Al-Fudail, and Mellar, (2007).

reduce stress and indicates the need to look at teachers' coping strategies. The empirical data suggests that coping strategies, such as increased training, practicing before use, changing the style of teaching, and classroom management training were effective, and these should, therefore, be encouraged. On the other hand, coping strategies, such as blaming one's self or learning to accept the problems, are not very effective, and therefore, teachers should be warned against such strategies. An important follow-up study would be to see whether mentoring in such coping strategies would be effective in reducing stress.

Whilst this study points towards specific features of the use of technology in the classroom that might be improved, perhaps the real importance of this study lies in pointing to an alternative way of thinking about the problems of classroom implementation of e-learning. By conceptualizing some of the issues around implementation of technologies in the classroom in terms of technostress (and in particular of Teacher-Technology Environment fit), this study suggests alternative solutions to implementation problems that go beyond simple provision of additional resources. The model proposed also gives managers and teachers looking at the implementation of e-learning a framework to analyse (and predict) the potential stresses in the classroom and hence to plan solutions to overcome these. In considering the value of increased investment in ICT in education, the hidden costs of technostress and the management of this stress need to be factored into the economic equations, as without doing so some of the value of the initial investment will be lost.

# BIBLIOGRAPHY


Åborg, C. (2002). *How does IT feel @ work – and how to make IT better: Computer use?* Uppsala, Uppsala University.

Abel, M. H. (2002). Humor, stress, and coping strategies. *Humor*. 15(4), 365-381. Retrieved June 30, 2007 from, http://www.csulb.edu/~djorgens/abel.pdf

Adams, E. (2001). A proposed causal model of vocational teacher stress. *Journal of Vocational Education and Training*, 53, 223-246.

Adelmann P. K. (1987). Occupational complexity, control, and personal income: Their relation to psychological well-being in men and women. *Journal of Applied Psychology*, *72*(4) 529–537.

Advancing Excellence in Technological Literacy (2003). Student assessment, professional development, and program standards. The technology teacher, 62 (6). Retrieved March 3, 2007, from http://www.questia.com/ PM.qst?a=o&d=5002524066

Albinsson, P. A., Dahlbäck, N. and Morin, M. (2004). Coupling models of complexity and models of cognition in a systems design process. *Proceedings of the European Conference on Cognitive Ergonomics (ECCE-12)*. York, UK

Allen, P. (1998). Preface. Building an action plan: A sequel to the kit Health and Wellbeing at Work. Melbourne: DOE.

Al-Fudail, M. and Mellar, H. (2007) Investigating teacher stress when using technology. *Computers and Education*. doi:10.1016/j.compedu.2007.11.004

Al-Mohannadi, A. (2004). The use of the person-environment fit theory to look at the experiences of Qatari physical education teachers, focusing on causes of stress and attitudes toward teaching physical education. Unpublished Doctoral Thesis. Brunel University: London.

Altmaier, E. M. (1983). *Helping students manage stress*. San Francisco: Jossey-Bass.

Anderson, L. M., Blumenfeld, P., Pintrich, P. R., Clark, C. M., Marx, R. W. and Peterson, P. (1995). Educational psychology for teachers: Reforming our courses, rethinking our roles. *Educational psychologist*, 30 (3) 143-1 57.

Anderson, N. and Baskin, C. (2002). Can we leave it to chance? New learning technologies and the problem of professional competence. *International education journal, 3*, 126-137.

Andreassi, J. L. (2000). *Psychophysiology: Human behaviour and physiological response*. Mahwah: Lawrence Erlbaum Associates.

Annetta, L. and Matus, J. (2004). Analysis of satisfaction and perceived learning of science in different distance education delivery modes for rural elementary school teachers involved in a professional project. *International journal of science and mathematics education, 1*, 311-331.

Antonietti, A., and Giorgetti, M. (2006). Teachers' beliefs about learning from multimedia. *Computers in Human Behavior*, 22(2), 267–282.

Arikewuyo, M. O. (2004). Stress management strategies of secondary school teachers in Nigeria. *Educational research*, 46, 195-207.

Arnetz, B. B. and Wiholm, C. (1997). Technological stress: psychophysiological symptoms in modern offices. *Journal of psychosomatic research 43(1)*, 35-42.

Arthur, W. B. (1993). Why do things become more complex? *Scientific American*, 268 (5).

Assistant Masters and Mistresses Association (AMMA). Working Party on Stress. (1987). *Teacher stress - Where do we go from here?* London: Assistant Masters and Mistresses Association.

Ajzen, I. (2008) Behavioral Interventions Based on the Theory of Planned Behavior: Brief Description of the Theory of Planned Behavior Retrieved on June 20, 2008, from http://www-unix.oit.umass.edu/aizen/pdf/tpb.intervention.pdf

Bachrach, K. M., and Zautra A. J. (1985). Coping with a community stressor: The threat of a hazardous waste facility. *Journal of health and social behaviour*, 26 (2), 127-141.

Bai, X., Michael B, Chris E, Alan H, Bunhee J, Sally K, Rhonda K, Seung-Ah L, Paul M, David M, Michael N, Weiping P, Ruqian T, Brandon W, and Kristy W. (2000), St. Andrew's Middle School Technology Integration: Analysis and recommendations, *Graduate School of Library and Information Science; Austin; The University of Texas.*

Balkin, R. S., Buckner, D. Swartz, J., and Rao, S. (2005). Issues in classroom management in an interactive distance education course. *International journal of instructional media,* 32(4), 363. Retrieved on March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5014492227

Ballance, C. T., and Rogers, S. U. (1991). Psychology of computer use: XXIV, Computer-related stress among technical college students. *Psychological reports*, 69, 539-542.

Ballance, C. T., and Ballance, V. (1992). Psychology of computer use: XXVI, Computer-related stress and in-class computer usage. *Psychological reports*, 71, 172-174.

Ballance, C. T., and Ballance, V. (1996). Psychology of computer use: XXXVII, Computer-related stress and amount of computer experience. *Psychological reports*, 78, 958-970.

Bannister, F., and Remenyi, D. (2003). Evaluating the information society: Some conceptual issues: ECITE 03 Proceedings. Retrieved on March 3, 2007, from http://www.tcd.ie/Statistics/staff/personalfolders/danremenyi/InformationSoc.pdf.

Barker, C., Pistrang, N., and Elliott, R. (1994), *Research methods in clinical and counselling psychology* (M. Sapoah, Shoagee, M. and Rushdee A. in (1999) Cairo Anglo-Egyptian (Arabic) Trans.). New York: Wiley.

Barkerr, G. (1968). *Ecological psychology*. Stanford, CA: Stanford University Press.

Barone, D. F. (1995). Work stress conceived and researched transactionally. In R. Crandall and P. L. Perrewe (Eds.), *Occupational stress: Handbook*. Washington: Taylor & Francis.

Battram, A. and Industrial Society. (1998). *Navigating complexity*. London: Industrial Society.

Beck, U. (1992). *Risk society: Towards a new modernity*. London: Sage.

Beehr, T. A. and Franz, T. M. (1987). The current debate about the meaning of job stress. In J. M. Ivancevich and D. C. Ganster (Eds.), *Job stress: From theory to suggestions*. New York: Haworth Press.

Beehr, T. A. (1998). An organizational psychology meta-model of occupational stress. In C. L. Cooper (Ed.), *Theories of organizational stress*. Oxford; New York: Oxford University Press.

Berger, D. E., Pezdek, K. and Banks, W. P. (1987). *Applications of cognitive psychology: Problem solving, education, and computing*. Hillsdale, NJ: Lawrence Erlbaum.

Beynon, J. and Mackay, H. (1993). *Computers into classrooms: More questions than answers*. London; Washington D.C: Falmer Press.

Bichteler, J. (1986) Human aspects of high tech in Special Libraries.' *Special Libraries*, 77, (3) 121-128.

Birdi, K. S. and Zapf, D. (1997). Age differences in reactions to errors in computer-based work. *Behaviour and information technology*, 16, (6), 309-319.

Bitner, N. and Bitner, J. (2002). Integrating technology into the classroom: Eight keys to success. *Journal of technology and teacher education*, 10 (1), 95. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5002470068

Blase, J. J. (1986). A qualitative analysis of sources of teacher stress: Consequences for performance. *American educational research journal*, 23 (1), 13-40.

Blix, A. G., Cruise, R. J., Mitchell, B. M., and Blix, G. G. (1994). Occupational stress among university teachers. *Educational research*, 36 (2), 157-169.

Bonnel, A. M.and Hafter, E. R. (1998). Divided attention between simultaneous auditory and visual signals. *Perception and psychophysics*, 60 (2), 179-190.

Borg, M. G. and Falzon, J. M. (1991). Sources of teacher stress in Maltese primary schools. *Research in education*, 46, 1–15.

Bowers, T. and Mclver, M. (2000). *Ill health retirement and absenteeism amongst teachers. Research brief, no, 235*. London: Department of Education and Employment Publications.

Bozionelos, N. (2001). Computer anxiety: Relationship with computer experience and prevalence. *Computers in human behavior*, 17, 213-224.

Bradley, G. (2000). The information and communication society; how people will live and work in the new millennium. *Ergonomics*, 43, 844-857.

Bradley, G. (2003). *Information and communication technology (ICT) for deepening human and societal qualities*. Speech presented at the Royal Institute of Technology (KTH), Department of Microelectronics and Information Technology, Isafjordsgatan. Retrieved March 3, 2007, from http://www.disability.bcs.org.uk/docs/icat03/GunillaBradley.pdf

Bradley, G. and Russell, G. (1997). Computer experience, school support, and computer anxiety. *Educational psychology*, 17 (3), 267-284.

Braverman, H. (1974). *Labor and monopoly capital: The degradation of work in the twentieth century*. New York: Monthly Review.

Breivik, P. S. (2001). Student learning in the information age. Retrieved on March 3, 2007, from http://www.ntlf.com/html/lib/ilul_pref.htm

Bridger, R. S. (2003). Introduction to ergonomics. New York: Taylor & Francis. Retrieved on March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=107925980

Brief, A. P. and George, J. M. (1995). Psychological stress and the workplace: A brief comment on Lazarus' Outlook. In R. Crandall & P. L. Perrewe (Eds.), *Occupational stress: Handbook*. Washington: Taylor & Francis.

British Educational Research Association BERA. (2004) Revised Ethical Guidelines for Educational Research. Retrieved on Sep 21, 2007 http://www.bera.ac.uk/publications/pdfs/ETHICA1.PDF?PHPSESSID=be0a577071019e2dcd2151a9485f0c38

British Psychological Society: Code of Ethics (2002). Retrieved on June 21, 2007, from http://www.ioe.ac.uk/doctoralschool/BPS.pdf

Brod, C. (1982). Managing technostress: Optimizing the use of computer technology. *Personnel journal*, 61, 753-757.

Brod, C. (1984). *Technostress: The human cost of the computer revolution*. Reading, Massachusetts: Addison-Wesley.

Brophy, D. W. (1979). Teacher behaviour and its effects. *Journal of educational psychology*, 71, 733-750.

Brown G. W. (1990). What about the real world? Hassles and Richard Lazarus. *Psychological inquiry*, 1(1), 19-22.

Brown, S. and McIntyre, D. (1993). *Making sense of teaching*. Buckingham; Open University Press.

Brzycki, D., and Dudt, K. (2005). Overcoming barriers to technology use in teacher preparation programs. *Journal of technology and teacher education*. 13 (4), 619. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5011517184

Bubb, S. and Earley, P. (2004). *Managing teacher workload: Work-life balance and wellbeing*. London: Paul Chapman.

Bullinger, H.J., and Ziegler, J. (1999). Human-computer interaction: Communication, cooperation, and application design. *Proceedings of HCI International '99 (the 8th International Conference on Human-Computer Interaction), Munich, Germany, August 22-26, 1999 Volume 2*. Mahwah: Lawrence Erlbaum Associates.

Bunge, C. A. (1991). CD-ROM Stress. *Library journal*, 116, 63-64.

Burke, M. A. S. (2005). *Technological stressors of Louisiana baccalaureate nurse educators*. Louisiana: Louisiana State University.

Buzhardt, J. and Heitzman-Powell, L., (2005). Stop blaming the teachers: The role of usability testing in bridging the gap between educators and technology. *Electronic journal for the integration of technology in education*, 4, 13-29.

Cacioppo, J. T. and Louis, G. T. (1990). Inferring psychological significance from physiological signals. *American psychologist*, 45 (1), 16-28.

Calloway, J. (2004, January). Technology, stress and the lawyer's quality of life. *Ontario Bar Association*, 1(2). Retrieved on March 3, 2007, from http://www.oba.org/en/gen/dec03/tech.aspx.

Camp, W.G. and Heath-Camp, B. (1990). *The teacher proximity continuum: A conceptual framework for the analysis of teacher-related phenomena*. Paper presented at the Annual Meeting of the American Vocational Association, Cincinnati, Ohio.

Caplan, R. D., Cobb, S., French, J. R. P., Harrison, V. R. and Pinneau, S. R. (1980). *Job demands and worker health: Main effects and occupational differences*. Ann Arbor, MI: Institute for Social Research.

Caplan, R. D., Cobb, S., and French, J. R. P. (1975). Relationship of cessation of smoking with job stress, personality, and social support. *Journal of applied psychology*, 60, 211-219.

Caplan, R. D. and Harrison, R. V. (1993). Person-environment fit theory: Some history, recent development, and future directions. *Journal of social issues*, 49, 253-275.

Carayon, P., Smith, M. J. and Haims. (1999). Work Organization, Job Stress and Work-Related Musculoskeletal Disorders. Human Factors 41(4), 644. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5001890955

Carlyle, D. E. E. (2001). *Emotion and stress-related illness among secondary teachers*. Open University.

Carver, C. S., Scheier, M. F. & Weintraub, J. K. (1989). Assessing coping strategies: A theoretically based approach. *Journal of personality and social psychology*, 56, 267-283.

Cassidy, T. (1999). *Stress, cognition and health*. New York: Routledge.

Castells, M. (1996). *The information age: Economy, society and culture. The rise of the network society.* Oxford: Blackwell.

Chemers, M. M., Hays, R. B., Rhodewalt, F., and Wysocki, J., (1985) A person-environment analysis of job stress: A contingency model explanation. *Journal of Personality and Social Psychology.* 49 (3) 628-635

Chen, H. C. (2003). *Stress in teaching: A comparison of general and special education teachers in junior high schools in Taiwan.* Bristol: University of Bristol.

Chin-Yi, S. (2003). *Stress in tutor-teachers in Taiwan: Exploration and an evaluation of a stress management programme.* University of Surrey: Surrey.

Christensen, R. (2002). Effects of technology integration education on the attitudes of teachers and students. *Journal of research on technology in education*, 34(4), 411-433.

Clute, R. (1998). *Technostress: A content analysis.* (Master's Research Paper, Kent State University). Retrieved on June 30, 2007, from http://eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/16/ef/f9.pdf.

Cobb, S., and Rose, R. M. (1973). Hypertension, peptic ulcers, and diabetes in air traffic controllers. *Journal of the American Medical Association*, 224, 489-492.

Cohen, E., Meyer, J., Scott, W. and Deal, T. (1979). Technology and teaming in the elementary school. *Sociology of education,* 52, 20-33.

Cohen, S. Kamarck, T. and Mermelstein, R. (1983). 'A global measure of perceived stress. *Journal of health and social behaviour,* 24 (4), 385-396. Retrieved on June 30, 2007, from http://links.jstor.org/sici?sici=00221465%28198312%2924%3A4%3C385%3AAGMOPS%3E2.0.CO%3B2-2&size=LARGE

COMPUTING@UW-MADISON. (2004). Coping with technology's dark side.. Retrieved on June 30, 2007, from http://www.doit.wisc.edu/news/story.asp?filename=38.

Cook, D. and Finlayson, H. (1999). *Interactive children, communicative teaching: ICT and classroom teaching.* London: Open UP.

Cooper, C. L., and Marshall, J. (1978). *Understanding executive stress.* London: Macmillan.

Cooper, C. L., and Payne, R. (1978). *Stress at work.* Chichester & New York: Wiley.

Cooper, C. L., and Dewe, P. (2004). *Stress: A brief history.* Oxford: Blackwell Publishing.

Cooper, C. L., Dewe, P. and O'Driscoll, M. P. (2001). *Organizational stress: A review and critique of theory, research, and applications.* Thousand Oaks, Calif; London: Sage.

Cooper, C. L., and Marshall, J. (1976). Occupational sources of stress: A review of the literature relating to coronary heart disease and mental ill health. *Journal of occupational psychology,* 49, 11-28.

Cooper, N. and Stevenson, C. (1998). New science and psychology. *The psychologist,* 11, 484-485.

Coovert, M. D. and Thompson, L. F. (2003). Technology and workplace health. In J. C. Quick & L. E. Tetrick (Eds.), *Handbook of occupational health psychology* (pp. 221-241). Washington, D.C.: American Psychological Assoc.

Coovert, M. D., Thompson, L. F. and Craiger, J. P. (2005). Technology. In J. Barling, E. K. Kelloway & M. R. Frone (Eds.), *Handbook of work stress* (pp. 299-324). Thousand Oaks, Calif.; London: Sage Publications.

Copeland, W.D., Birmingham, C., DeMeulle, L., D'Emidio-Caston, M., and Natal, D. (1994). Making meaning in classrooms: An investigation of cognitive process in aspiring teachers, experienced teachers, and their peers. *American educational research journal,* 31(1), 166-196.

Corning, P. A. (1998) Complexity is just a word! Retrieved on June 30, 2007, from http://complexsystems.org/commentaries/jan98.html

Costa Jr., P. T. and McCrae, R. R. (1990). Personality: Another "hidden factor" in stress research. *Psychological inquiry,* 1(1), 22-24.

Cox, M., Rhodes, V. and Hall, J. (1988). The use of computer assisted learning in primary schools: Some factors affecting the uptake. *Computers and education,* 12, 173-178.

Cox, M., Christina, P., and Cox, K. (1999). What factors support or prevent teachers from using ICT in their classrooms? *British Educational Research Association Annual Conference.* Brighton: University of Sussex, Brighton.

Cox, M., Abbott, C., Webb, M., Blakeley, B., Beauchamp, T. and Rhodes, V. (2004a). A review of the research literature relating to ICT and attainment. Coventry: Becta

Cox, M.J. and Marshall, G. (2007) Effects of ICT do we know what we should know? *Educ Inf Technol* 12. 59–70 Retrieved July 17, 2008, from http://www.springerlink.com/content/r777x6072773u667/fulltext.pdf

Cox, M., National Council for Educational Technology, and King's College London. (1997). The effects of information technology on students' motivation. Coventry: National Council for Educational Technology ; London : King's College London.

Cox, M., and Webb, M. E. (Eds) (2004b). ICT and Pedagogy – A Review of the Research Literature. Coventry: Becta/London: DfES.

Cox, T. (1985). *Stress.* Hampshire: MacMillan Publishers Ltd.

Cox, T. (1987). Stress, coping and problem solving. *Work and Stress*, 1, 5-14.

Cox, T. (1988). Psychological factors in stress and health. In S. Fisher & J. Reason (Eds.), *Handbook of life stress.* London: Wiley.

Cox, T., Griffiths, A. and Rial-González, E. (2000). *Research on work-related stress.* Nottingham: Institute of Work, Health & Organisations University of Nottingham Business School.

Cox, T., and Mackay, C. (1981). A transactional approach to occupational stress'. In N. J. Corlett and J. E. Richardson (eds), *Stress, productivity and work design.* (pp. 75-95). London: Wiley.

Coyne, J. C., and Gottlieb, B. H. (1996). The mismeasure of coping by checklist. *Journal of personality*, 64, 959–991.

Cradler, J., and Bridgforth, E. (1996) Recent research on the effects of technology on teaching and learning. Retrieved on June 30, 2007, from http://www.wested.org/techpolicy/research.html

Cradler, J., Freeman, M., Cradler, R. and McNabb, M. (2002) Research implications for preparing teachers to use technology. *Learning and leading with technology*, 30, 50-54.

Crampton, S. M., Hodge, J.W., Mishra, J. M., and Price, S. (1995). Stress and stress management. SAM advanced management journal, 60(3), 10. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5000363883

Crandall, R. and Perrewe, P. L. (1995). *Occupational stress: Handbook.* Washington: Taylor and Francis.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches.* (2nd ed.). Thousand Oaks, Calif; London: Sage.

Crown, S., and Crisp, AH. (1979), *Manual of the Crown-Crisp experiential index.* London: Hodder and Stoughton.

Cuban, L. (1970). *To make a difference: Teaching in the inner city.* New York: Free Press.

Cuban, L. (1984). *How teachers taught: Constancy and change in American classrooms 1890-1980.* New York; London: Longman.

Cuban, L. (1993). *How teachers taught: Constancy and change in American classrooms 1890-1990.* (2nd ed.). New York; London: Longman.

Cuban, L. (2001). *Oversold and underused: Computers in the classroom.* Cambridge, Mass; London: Harvard University Press.

Cuban, L. and Teachers College Columbia University. (1986). *Teachers and machines: The classroom use of technology since 1920.* New York: Teachers College Columbia University.

Cummings, T. G., and Cooper, C. L. (1979). Cybernetic framework for studying occupational stress. *Human Relations*, 32. 395-418.

Dahloff, U. S. (1971). *Ability grouping, content validity, and curriculum process analysis.* New York: Teachers College Press.

Daley, B. J., Watkins, K., Williams, S.W., Courtenay, B. and Davis, M. (2001). Exploring learning in a technology-enhanced environment. *Educational technology & society*, 4(3), 126-138. Retrieved March 6, 2007 from http://ifets.ieee.org/periodical/vol_3_2001/daley.pdf

Danna, K. and Griffin, R. W. (1999). Health and well-being in the workplace: A review and synthesis of the literature. *Journal of management*, 25, 357-384.

Darwish, J. (2002). *Teacher stress, its sources and ways of coping with it among secondary science teachers (males and females) in ten Bahraini secondary government schools.* Sheffield: University of Sheffield.

Davies, D. (1986). *Maximizing examination performance: A psychological approach.* London: K. Page.

Davis-Millis, N. (1998). Technostress and the organization: A manager's guide to survival in the information age. Retrieved May 18, 2007, from http://web.mit.edu/ninadm/www/mla.htm

Davis, F., Bagozzi, R., Warshaw, P. (1989) User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. Management Science, 35 (8) 982-1003 Retrieved July 20, 2008 from http://www.jstor.org/stable/pdfplus/2632151.pdf

Dawes, L. (1999). Chalky and the interactive whiteboard: Media representation of teachers and technology. Paper Presented to the *British Educational Research Association*. London. March.

Dertouzos, M. L. (1997). *What Will Be: How the New World of Information Will Change Our Lives*: Harper San Francisco.

DeVaus, D. (2002). *Surveys in social research*. London: Routledge

Dewe, P. J. (1985). Coping with work stress: An investigation of teachers' actions. *Research in education*, 33, 27-40.

Dewe, P. J. (1991). Primary appraisal, secondary appraisal and coping: Their role in stressful work encounters. *Journal of occupational psychology*, 64 (4), 331-351.

Dick, Van. R. and Wagner, U. (2001). Stress and strain in teaching: A structural equation approach. *British journal of educational psychology*, 71, 243-259.

Dimsdale, J. E., and Moss, J. (1980). Plasma catecholamines in stress and exercise. *JAMA*, 243(4).

Dinham, S. (2006). A good teacher in every classroom. *Australian journal of education* 50(1) 95. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5014888443

Dobb, L. (1990). Technostress: Surviving a database crash. *Reference services review*, 18, 65-68.

Dollard, M. F., Winefield, A. H. and Winefield, H. R. (2003). *Occupational stress in the service professions*. New York: Taylor & Francis. Retrieved June 3, 2007, from http://www.questia.com/PM.qst?a=o&d=108097251

Doublet, S. (2000). *The stress myth*. Chesterfield, MO: Science & Humanities Press.

Doyle, W. (1977). Learning the classroom environment: An ecological analysis. *Journal of teacher education*, 28, 51-55.

Doyle, W. (1979a). Classroom tasks and student's abilities. In P. L. Peterson & H. J. Walberg (Eds.). *Research on teaching* (pp. 183-209). Berkeley, CA: McCutchan.

Doyle, W. (1979b). Making managerial decisions in classrooms. In: D. L. Duke (Ed.) *Classroom management. 78th yearbook of the national society for the study of education part 2*. Chicago, IL: University of Chicago Press.

Doyle, W. (1980). *Classroom management*. West Lafayette: Kappa Delta Pi.

Doyle, W. (1981). Research on classroom contexts. *Journal of teacher education*, 32, 3-6.

Doyle, W. (1982), *Design for analysing classroom activities* Austin, TX: Research and Development Centre for Teacher Education, Austin: University of Texas.

Doyle, W. (1983). Academic work. *Review of educational research*, 53, 159-199.

Doyle, W. & Carter, K. (1984). Academic tasks in classrooms. *Curriculum inquiry*, 14 (2) 129-149.

Doyle, W. (1986). Classroom organization and management. In M. Wittrock (Ed.), *Handbook of research on teaching* (pp. 392-431). New York: Macmillan.

Doyle, W. (1990a). Case methods in teacher education. *Teacher education quarterly*, 17 (1) 7-15.

Doyle, W. (1990b). Classroom knowledge as a foundation for teaching. *Teachers college record*, 91 (3) 347-360.

Driskell, J. E., and Salas, E. (1996). Stress and human performance. Mahwah, NJ: Lawrence Erlbaum Associates. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=9650247

Dunham, F. and Lowdermilk, R. R. (1956). *Television in our schools*. Washington D.C: United States Department of Health Education and Welfare.

Dunham, F., Lowdermilk, R. R., and Broderick, G. G. (1957). *Television in education*. Washington D.C.: United States Department of Health Education and Welfare.

Dunham, J. (1984). *Stress in teaching*. London: Croom Helm.

Dunham, J. (1989). *Stress in teaching*. London: Routledge.

Dunham, J. (1992). *Stress in teaching. (2nd e.d)*. London: Routledge.

Dunham, J. (1995). *Developing effective school management*. London: Routledge.

Dunham, J. and Varma, V. (1998). *Stress in teachers: Past, present and future*. London: Whurr Publishers Ltd.

Dunham, J. (1988). *Research methods in psychology*. New York; London: Harper & Row.

Dupagen, M. and Krendl, K. A. (1992). Teachers' attitudes toward computers: A review of the literature. *Journal of research on computing in education*, 24, 420-429.

Dyck JL., and Smither, JA. (1994). Age differences in computer anxiety: The role of computer experience, gender and education. *Journal of educational computing research* 10 (3), 239–248.

Dymoke, S. (2005), Wireless keyboards and mice: Could they enhance teaching and learning in the secondary English classroom. *English in education*, 39, 62-77.

Ebbutt, D., Robson, R., and Worrall, N. (2000). Educational research partnership: Differences and tensions at the interface between the professional cultures of practitioners in schools and researchers in higher education. *Teacher development,* 4(3) 319 -338.

Eddy, J. P., and Spaulding, D. (1996), Internet, computers, distance education and people failure: Research on technology. *Education* 116(3) 391. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5000367901

Edwards, C., Walton, G., and Day, J. M. (1995). Impel project: The impact on people of electronic libraries. *'Aslib proceedings,* 47, 203-208.

Edwards, J. R., and Cooper, C.L. (1988). The impacts of positive psychological states on physical health: A review of theoretical framework. *Social science and medicine,* 27, 1447-1459.

Edwards, J. R., Caplan, R. D. and Harrison, R. V. (1998), Person-Envirnoment Fit theory: Conceptual Foundation, Empirical Evidence, and Directions for Future Research. In C. L. Cooper (ed.), *Theories of organizational stress.* Oxford; New York: Oxford University Press.

Edwards, J.R. and Cooper, C.L. (1990). The Person-Environment Fit Approach to Stress: Recurring problems and Some Suggested Solutions. *Journal of Organizational Behavior,* 11 (4), 293-307.

Elder, V. B., Gardner, E. P., and Ruth, S. R. (1987). Gender and age in technostress: effects on white collar productivity. *Government Finance Review, 3,* 17-21

Engs, R. and Wantz, M. (1978). *Teaching health education in the elementary school.* Boston: Houghton Mifflin.

Enochs, L. G., Riggs, I. M., and Ellis, J. D. (1993). The development and partial validation of microcomputer utilization in teaching efficacy beliefs instrument in a science setting. *School Science and Mathematics, 93,* 257-263

Eppler, M. j. (2003), A Framework for Information Overload Research in Organizations: Marketing, MIS. Retrieved March 3, 2007, from http://www.bul.unisi.ch/cerca/bul/pubblicazioni/com/pdf/wpca0301.pdf

EURO RSCG Worldwide. (2002 ), Simplification in an age of information overload. Retrieved March 3, 2007, from http://www.eurorscglife.ca/InformationOverload.pdf.

Evans-Andris, M. (1995), An examination of computing styles among teachers in elementary schools. *Educational Technology Research and Development, 43,* 15-31.

Evans, P. E. (2002). *An analysis of secondary teachers' perceived stress linked to the management styles of their Heads of Department.* Open University

Eysenck, M. W. (1984). *A handbook of cognitive psychology.* London: Erlbaum.

Eysenck, M. W., and Keane, M. T. (2000). *Cognitive psychology: a student's handbook.* (4th ed.). Hove: Psychology P.

Feltovich, P., Spiro, R., and Coulson, R. (1997). Issues of expert flexibility in contexts characterized by complexity and change, In P. Feltovich, K. Ford. & R. Hoffman (Eds.). Expertise in context (pp. 125-146). Cambridge, MA: AAAI/MIT Press

Fielding, M. and Gall, M. (1982). *Personality and Situational Correlates of Teacher Stress and Burnout,* ERIC Document Reproduction Service No. ED219355. New York: American Educational Research Association, March.

Fielding, R. (2003), IT in schools fails to raise standards. Retrieved March 3, 2007, from http://www.computing.co.uk/vnunet/news/2121247/schools-fails-raise-standards, *VNU Business Publications.* .

Fisher, S. (1994). *Stress in Academic Life: the mental assembly line.* Buckingham: Society for Research into Higher Education and Open University Press.

Fisher, R. (2001). Analysing the Role of the Teacher in Early Reading: a lesson for researchers. *Teachers and Teaching: theory and practice, 7 (3)* 297 – 313

Fleishman, J. A. (1984). Personality Characteristics and Coping Patterns. *Journal of Health and Social Behaviour,* 25 (2), 229-244.

Fishbein, M. and Ajzen, I. (1975). *Belief, attitude, intention, and behaviour: an introduction to theory and research.* Addison-Wesley Pub. Co. Reading, Mass.

Fletcher-Flinn, C. M., and Suddendorf, T. (1996). Computer attitudes, gender and exploratory behavior: A developmental *study. Journal of Educational Computing Research.* 5(4). 369-392.

Foley, J. (1995), Managing Information: *Infoglut: informationweek.* Retrieved March 3, 2007, from http://www.informationweek.com/551/51mtinf.htm

Folkman, S. Lazarus, R. S. Gruen, R. J. DeLongis, A. (1986). Appraisal, coping, health status, and psychological symptoms. *Journal of Personality and Social Psychology.* 50 (3) 571-579.

Frankenhaeuser, M., Gardell, B. (1976). Underload and overload in working life: Outline of a multidisciplinary approach. *Journal of Human Stress 2*: 35-46.

Fraser, B. J. and Rentoul, A. J. (1980). Person-Environment Fit in Open Classrooms. *Journal of Educational Research*, 73 (3) 159-167.

French, JRP., Rodgers, WL., and Cobb, S. (1974). Adjustment as person-environment fit. In: Coelho, G., Hamburg, D. and Adams, J. (Eds). *Coping and Adaptation*, (pp: 316-333), New York: Basic Books.

French, JRP., Caplan, RD. and Harrison, RV. (1982). *The mechanisms of job stress and strain.* Chichester: Wiley.

Frese, M. and Zapf, D. (1999). On the Importance of the Objective Environment in Stress and Attribution Theory. Counterpoint to Perrewé and Zellars, *Journal of Organizational Behavior*, 20, (5) 761-765.

Fried, Y., Slowik, L. H., Ben-David, H. A. and Tiegs, R. B. (2001). Exploring the relationship between workspace density and employee attitudinal reactions: An integrative model. *Journal of Occupational and Organizational Psychology.* 74 (3) 359-372.

Fried, Y., Melamed, S. and Ben-David, H. (2002). The joint effects of noise, job complexity, and gender on employee sickness absence: An exploratory study across 21 organizations/the CORDIS study. *Journal of Occupational and Organizational Psychology*, 75 (2) 131-144.

Friedman, I. A. (1995). Student behavior patterns contributing to teacher burnout. *Journal of Educational Research,* 88(5) 281-289.

Fullan, M. and Stiegelbauer, S. (1991). *The new meaning of educational change.* (2nd ed.). London: Cassell.

Fuller, H. L. (2000). First teach their teachers: Technology support and computer use in academic subjects. *Journal of Research on Computing in Education*, 32, 511-537.

Furnham, A. (1997). *The psychology of behaviour at work: the individual in the organization.* Hove: Psychology Press.

Galanouli, D., Murphy, C., and Gardner, J. (2004). Teachers perceptions of the effectiveness of ICT-competence training. *Computers & Education* 43, 63-79

Gao, L. (2005). *How Chinese government schools reduce teacher's [sic] teaching stress in Guandong province in China.* University of Birmingham: Birmingham.

Gärdenfors, P. and Johansson, P. (2005), *Cognition, education, and communication technology.* Mahwah, N.J. London. Lawrence Erlbaum Associates.

Genco, P. (2000). Technostress in our schools, *Access, 14* (14), 12-13.

Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report.* 8(4), 597-607, Retrieved on June 20, 2007, from http://www.nova.edu/ssss/QR/QR8-4/golafshani.pdf

Goldberg, D. P. (1972). *The detection of psychiatric illness by questionnaire.* London: OUP.

Goldberg, D. P., and Hiller, V. F. (1979). A scaled version of the General Health Questionnaire. *Psycho Med,* (1), 139–145.

Goldberg, D. and Williams, P. (1988). *A user's guide to the general health questionnaire.* Windsor: NEFR Nelson.

Goldberger, L. and Breznitz, S. (1993). *Handbook of stress: Theoretical and clinical aspects* (2nd ed.). New York, NY: Free Press.

Gondi, V. (2003) What is Complexity? Retrieved on May 8, 2007, from http://blogs.law.harvard.edu/vgondi/discuss/msgReader$87?mode=topic&print-friendly=true

Good, T. (1979). Teacher effectiveness in the elementary school: What we know about it now. *Journal of Teacher Education, 30,* 52-64.

Good, T., and Power, C. (1976). Designing successful classroom environments for different types of students. *Journal of Curriculum Studies, (8)*1-16.

Gore, J., M. and Gitlin, A. D. (2004). [Re]Visioning the academic–teacher divide: power and knowledge in the educational community. *Teachers and Teaching: theory and practice. 10(1)* 35 – 58.

Gray, H. L., and Freeman, A. (1988). *Teaching without stress.* London: Paul Chapman Publishing.

Great Britain. Education Service Advisory Committee, and Great Britain. Health and Safety Commission. (1990). *Managing occupational stress: a guide for managers and teachers in the schools sector.* London: Hmso.

Great Britain. Health and Safety Executive. (1995). *Stress at work: a guide for employers.* Sudbury: HSE Books.

Grebner, S., Semmer, N. K., Faso, L. L., Gut, S., Kälin, W. and Elfering, A. (2003). Working conditions, well-being, and job-related attitudes among call centre agents. *European Journal of Work and Organizational Psychology*, 12(4) 341 – 365.

Greenfield, T. (2002). *Research methods for postgraduates.* (2nd ed.). London: Arnold.

Grimshaw, J. (1999). *Employment and health: psychosocial stress in the workplace.* London: British Library.

Guglielmi, R. S. and Tatrow, K. (1998). Occupational Stress, Burnout, and Health in Teachers: A Methodological and Theoretical Analysis. *Review of Educational Research, (*68) 61-99.

Gutierres, S. E., Sanez, D. S., and Green, B. L. (1994). Job stress and health outcomes among white and Hispanic employees: a test of the person-environment fit model. In Keita, G. P. and Hurrell Jr., J. J. *Job Stress in a changing workforce: Investigating gender, diversity, and family issues*. (pp. 39-54). Washington: American Psychological Association.

Hackman, J. R. and Oldham, G. R. (1980). *Work Redesign.* Reading, MA: Addison-Wesley.

Hadley, M. and Sheingold, K. (1993), Commonalities and distinctive Patterns in Teachers' Integration of Computers. *American Journal of Education, (101)* 261-315.

Haegeland, W. (2000). Stress proofing in a media convergent work environment Interim project report: Safety Services, BBC. Retrieved on March 3, 2007, from http://www.ergonom.no/downloads/001-006-Haegland.pdf.

Hamborg, K-C. and Greif, S. (2003). New Technology and Stress. In M. J. Schabracq, J. A. M. Winnubst and C. L. Cooper (eds.), *The Handbook of work and health psychology.* Chichester John Wiley and Sons Ltd.

Harper, S. (2000), Managing Technostress in UK Libraries: A Realistic Guide Retrieved on March 3, 2007, from http://www.ariadne.ac.uk/issue25/technostress/.

Harré, R. and Lamb, R. (1983). *The encyclopaedic dictionary of psychology.* Oxford: Blackwell Reference.

Harris, J. R. (1995). An Examination of the Transaction Approach in Occupational Stress Research. In R. Crandall and P. L. Perrewe (eds.), *Occupational stress: handbook.* Washington: Taylor & Francis.

Harris, K. R., Halpin, G. and Halpin, G. (1985). Teacher Characteristics and Stress. *Journal of Educational Research*, (78) 346-350.

Harrison, R. V. (1978). Person-Environment Fit and Job Stress. In Cary. L. Cooper and Roy. Payne (eds.), *Stress at work.* Chichester: Wiley.

Harrison, R. V., Moss, G. E., Dielman, T. E., Horvath, W. J. and Harlan, W. R. (1987). Person-Environment fit, Tape A behaviour, and work strain: the complexity of the process. In J. C. Quick, et al (ed.), *Work stress: health care systems in the workplace.* New York: Praeger.

Hart, N., and Hurd, J. (1999). *Teacher stress: the consequences of harassment and bullying,* Suffolk: Monitor P.

Hart, P. M., Wearing, A. J. and Headey, B. (1995). Police stress and well-being: Integrating personality, coping and daily work experiences. *Journal of Occupational & Organizational Psychology*, (68)133-156.

Hedberg, J. G. (1989). Rethinking the selection of learning technologies. *Australian Journal of Educational Technology,* 5132-160.

Henderson, L. (1995-2006). On-line survey by The Shyness Institute on shyness and technology use Social Interaction and Technology Use Questionnaire. Retrieved on June 26, 2007 from http://www.shyness.com/.

Hepburn, C. G., Loughlin, C. A, and Barling, J. (1997). Coping with chronic work stress. In B. H. Gottleib (Ed.). *Coping with chronic stress.* New York: Plenum Press.

Heylighen, F. (1998). Technological acceleration: Principia Cybernetica Project (PCP). Retrieved on March 3, 2007, from http://pespmc1.vub.ac.be/CHINNEG.html.

Heylighen, F. (1999). Change and information overload: negative effects: Principia Cybernetica Project (PCP). Retrieved on Jun 11, 2007, from http://pespmc1.vub.ac.be/CHINNEG.html.

Heylighen, F. (2000). Referencing pages in Principia Cybernetica Web, F. Heylighen, C. Joslyn and V. Turchin (editors), Principia Cybernetica Web (Principia Cybernetica, Brussels) Retrieved on Jun 11, 2007, from http://pespmc1.vub.ac.be/REFERPCP.html.

Holm, K. (2000). It's ok to turn off your cell phone once in a while: 2000 American City Business Journals Inc Retrieved on March 3, 2007, from http://www.bizjournals.com/seattle/stories/2000/07/31/focus17.html.

Holmes, T. H. and Rahe, R. H. (1967). The social readjustments rating scales. *Journal of Psychosomatic Research*, (11)213-218.

Homan, R. (1991). *The Ethics of Social Research*. London: Longman.

House, J. (1984). Barriers to work stress: Social support. In Gentry, W. D., Benson, H., & Dewolf, C. (Eds.), *Behavioural medicine: Work, stress and health*. The Hague: Martins Nijhoff.

Howitt, D. and Cramer, D. (2005). *Introduction to statistics in psychology*. (3rd ed.). Harlow: Pearson.

Howitt, D. and Cramer, D. (2005). *Introduction to SPSS*. Harlow. Pearson.

Howitt, D. and Cramer, D. (2005). *Introduction to* research method in psychology. Harlow: Pearson.

Huang, S. L., Copley, J. V., Williams, S. E. and Waxman, H. C. (1992). Investigating middle school mathematics teachers' attitudes toward calculator use. In D. Carey, R. Carey, D.A. Willis, & J. Willis (Eds.), *Technology and Teacher Education Annual*: 1992 (pp. 401-405). Charlottesville, VA: Association for the Advancement of Computing in Education.

Hudiburg, R. A. (1996), Assessing and Managing Technostress. Retrieved on March 3, 2007, from http://www2.una.edu/psychology/alatalk.htm.

Hudiburg, R. A., and Necessary, J. R. (1996). Psychology of Computer Use: XXXV. Differences in computer user's stress and self-concept in college personnel and students. *Psychological Reports, (78)*931-937.

Hudiburg, R. A. (1991). Relationship of computer hassles, somatic complaints, and daily hassles. *Psychological Reports, (69)*1119-1122.

Hudiburg, R. A. and Necessary, J. R. (1996). Coping with Computer-Stress. *Journal of Educational Computing Research, (15)*113-124.

Hudiburg, R. A., Pashaj, I., and Wolfe, R. (1999). Preliminary investigation of computer stress and the big five personality factors. *Psychological Reports, 85*, 473-480.

Huey, B. M., and Wickens, C. D. (1993). *Workload Transition: Implications for Individual and Team Performance*. Washington, DC: National Academy Press.

Humfrey, J., Almeroth, K., Rollins, S. and Bimber, B. (2003). Managing Complexity in a Networked Learning Environment (Vol. 2003): University of California, Santa Barbara. Retrieved on March 3, 2007, from http://repositories.cdlib.org/isber/cits/3/.

Humphrey, G. (2000). Technostress, technophobia, neo-luddism and education: a study on educator attitudes toward technology integration in a public high school setting. Retrieved on July 20, 2007, from http://www.zkdigital.com/docs/technostress.pdf

Idzikowski, C., and Baddeley, A. D. (1983). Fear and dangerous environments. In R. Hockey (Ed.), *Stress and Fatigue in Human Performance*. Chichester: John Wiley and Sons Ltd, 123-144.

Jackson, P. W. (1968). *Life in classrooms*. New York: Holt, Rinehart & Winston.

Jackson, P. (1992). The enactment of the moral in what teachers do. *Curriculum Inquiry*, 22, 401–407.

Jacobson, C., Pousette, A. and Thylefors, I. (2001). Managing Stress and Feelings of Mastery among Swedish Comprehensive School Teachers. *Scandinavian Journal of Educational Research* 45 (1) 37-53.

Jarvela, S. and Niemivirta, M. (1999). The changes in learning theory and the topicality of the recent research on motivation. *Research Dialogue in Learning and Instruction*, 1 (2), 57-65.

Jarvis, M. (2002). *Teacher stress: a critical review of recent findings and suggestions for future research direction*. Stress News 14. Retrieved on May 9, 2007, from http://www.isma.org.uk/stressnw/teachstress1.htm.

Jellies, T. (1996). *What really stresses teachers? A Report on Four Years Research into What Stresses Teachers*. Droitwich: Stein-Kenny Gormley: Psychology in Action.

Jesshope, C. (2003). Towards the dynamic publication of multimedia presentations – A strategy for development. Retrieved on John 8, 2007 from http://staff.science.uva.nl/~jesshope/audiograph/Papers/altc2003.pdf

Jex, S. M. (1998). *Stress and job performance: theory, research, and implications for managerial practice*. Thousand Oaks, Calif. and London: Sage Publications.

Johansson-Hiden, B., Wastlund, E. and Wallin, S. (2003). *Reflecting ICT and Stress: Conceptual Connections and a Suggested Application*. Retrieved on May 9, 2007 from http://www.humanit.org/pdf/HumanIT_2003_Ch2_Johansson-Hiden_et_al.pdf.

Johnstone, M. and Scottish Council for Research in Education. (1989). *Stress in teaching: an overview of research*. Edinburgh: Scottish Council for Research in Education.

Johnston, D. (1999). Awakening; stress and the information age. Retrieved on May 9, 2007 from http://www.lessons4living.com/index.htm.

Johnston, D. (2004). Stress and the Information Age: Awakenings. Retrieved on May 9, 2007 from http://www.lessons4living.com/info.htm.

Jones, F. and Bright, J. (2001). *Stress: myth, theory, and research* Harlow: Prentice Hall.

Jones, F., Fletcher, B. C. And Ibbeton, K. (1991). Stressors and strains amongst social workers: demands, support, constraints and psychological health. *British Journal of Social Work,* (21) 443-469.

Joseph, R. (2000). *Stress free teaching: a practical guide to tackling stress in teaching, lecturing and tutoring.* London: Kogan Page.

Jovanovic, J., Lazaridis, K., and Stefanovic, V. (2006). *The theoretical approaches to the problem of occupational stress* Retrieved on May 9, 2007 from http://www.medfak.ni.ac.yu/Acta%20Facultatis/2006/3-broj/THEORETICAL%20APPROACHES%20TO%20PROBLEM%20OF%20OCCUPATIONAL%20STRESS.pdf.

Jyh-Rong, C. and Shih-Wen, H. (2007). A usability study on human–computer interface for middle-aged learners. *Computers in Human Behavior 23,* 2040-2063.

Karasek, R. (1979) Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign *Administrative Science Quarterly,* 24 (2) 285-308

Katz. R., and Wykes, T. (1985). The psychological difference between temporally predictable and unpredictable stressful events: Evidence for information control theories. *Journal of Personality and Social Psychology,* 48 (3)781-790.

Katz, Y. J. (2002) Attitudes affecting college students' preferences for distance learning. *Journal of Computer Assisted Learning* 18 (1), 2–9.

Kelly, P., and Colquhoun, D. (2003). Governing the stressed self: teacher health and well-being and effective schools. *Studies in the cultural politics of education,* 24, 191-204.

Kerka, S. (1997), Information Management (Vol. 2003): ACVE. Retrieved on May 9, 2007 from http://www.cete.org/acve/docgen.asp?tbl=mr&ID=64.

Kessler, RC., Barker, PR., Colpe, LJ., Epstein, JF., Gfroerer, JC., Hiripi, E., Howes, MJ., Normand, SL., Manderscheid, RW., Walters, EE., and Zaslavsky, AM. (2003). Screening for Serious Mental Illness in the General Population. *Arch Gen Psychiatry,* 60. 184–9. Retrieved on July 31, 2007 from http://archpsyc.ama-assn.org/cgi/content/full/60/2/184

Khine, M. S. and Fisher, D. (2003), *Technology-rich learning environments: a future perspective.* New Jersey; London: World Scientific.

Kian-Sam, H., Chee-Kiat, K. (2002). Computer Anxiety and Attitudes toward Computers among Rural Secondary School Teachers: A Malaysian Perspective. *Journal of Research on Technology in Education.* 35 (1), 27-48

Kimmel, A. (1996). *Ethical Issues in behavioral Research.* Oxford: Blackwell.

King, J., Bond, T. and Blandford, S. (2002). An investigation of computer anxiety by gender and grad. *Computers in Human Behavior 18* 69-84

Kiridis, A., Drossos, V., and Tsakiridou, H. (2006). Teachers Facing Information and Communication Technology (ICT): The Case of Greece. Journal of Technology and Teacher Education 14.1: 75+. Questia. Retrieved on Mar 3, 2007 from http://www.questia.com/PM.qst?a=o&d=5014509983

Kirsh, D. (2000). A few Thought on Cognitive Overload. *Intellectica,* 1 (30) 19-51. Retrieved on June 30, 2007 from http://citeseer.ist.psu.edu/cache/papers/cs/30430/http:zSzzSzinterruptions.netzSzliteraturezSzKirsh-Intellectica00-30.pdf/kirsh00few.pdf.

Klein, J., Moon, Y. and Picard, R. W. (1999). This computer responds to user frustration theory, design, results, and implications (Vol. 2004). Retrieved on May 9, 2007 from http://delivery.acm.org/10.1145/640000/632866/p242-klein.pdf?key1=632866&key2=8984206801&coll=portal&dl=ACM&CFID=22107998&CFTOKEN=48340011.

Knezek, G., Miyashita, K., and Sakamoto, T (1993) Cross-cultural Similarities in Attitudes toward Computers and the Implications for Teacher Education. *Journal of Information Technology for Teacher Education.* 2 (2) 193-204 http://www.informaworld.com/smpp/title~content=t716100724

Kock, A. D., Sleegers, P. and Voeten, M. J. M. (2005). New learning and choices of secondary school teachers when arranging learning environments. *Teaching and Teacher Education, 21,* 799-816.

Kort, B. and Reilly, R. (2002). Analytical Models of Emotions, Learning and Relationships: Towards an Affect-sensitive Cognitive Machine. Retrieved on May 9, 2007 from http://vismod.media.mit.edu/pub/tech-reports/TR-548.pdf

Koslowsky, M., (1998). *Modeling the stress-strain relationship in work settings.* London: Routledge.

Körner, J. (2006). *Searching in Lists While Driving: Identification of Factors Contributing to Driver Workload.* Ludwig-Maximilians-Universität: München.

Kounin, J. S. (1977). *Discipline and group management in classrooms.* Huntington, New York: R. E. Krieger Pub. Co

Krill, P. (2000). Overcoming information overload (Vol. 2003): infoworld. Retrieved on July 31, 2007 from http://archive.infoworld.com/articles/ca/xml/00/01/10/000110caoverload.xml.

Krohne, H. W. (1990). Personality as a Mediator between Objective Events and Their Subjective Representation. *Psychological Inquiry,* 1 (1) pp. 26-29.

Kupersmith, J. (1992). Technostress and the Reference Librarian. Retrieved on July 31, 2007 from http://www.jkup.net/tstr_ref.html.

Kupersmith, J. (1998). Technostress in the Bionic Library. Retrieved on July 31, 2007 from http://www.jkup.net/bionic.html Last accessed 30 June 2007.

Kupersmith, J. (2003). Library technostress survey results. Retrieved on July 31, 2007 from http://www.jkup.net/tstress-survey-2003.html.

Kupersmith, J. (2005). *Library Technostress Survey Results.* Retrieved on May 19, 2007 from http://www.jkup.net/tstress-survey-2003.html.

Kyriacou, C. (1980a). Coping actions and occupational stress among school teachers. *Research in Education,* (24) 57-61.

Kyriacou, C. (1980b). Stress, health and schoolteachers: a comparison with other professions. *Cambridge Journal of Education,* (1)154-159.

Kyriacou, C. (1981). Social Support and Occupational Stress among Schoolteachers. *Educational Studies,* (7)55-60.

Kyriacou, C. (1986). *Effective teaching in schools.* Oxford: Basil Blackwell.

Kyriacou, C. (1987). Teacher stress and burnout: an international review. *Educational Research,* (29)146-152.

Kyriacou, C. (1991). *Essential teaching skills.* Oxford: Basil Blackwell.

Kyriacou, C. (1997). *Effective teaching in schools: theory and practice.* (2nd ed.). Cheltenham: Stanley Thornes.

Kyriacou, C. (1998). *Essential teaching skills.* (2nd ed.). Cheltenham: Stanley Thornes.

Kyriacou, C. (1999). Student teachers' concerns during teaching practice. *Evaluation and Research in Education,* (31)18-31.

Kyriacou, C. (2000). *Stress-busting for teachers.* Cheltenham: Stanley Thornes.

Kyriacou, C. (2001). Teacher stress; directions for future research. *Educational Review,* (53) 27-35.

Kyriacou, C. and Pratt, J. (1985). Teacher stress and psychoneurotic symptoms. *British Journal of Educational Psychology,* (55)61-64.

Kyriacou, C. and Sutcliffe, J. (1977). Teacher stress: a review. *Educational Review,* (29)299-306.

Kyriacou, C. and Sutcliffe, J. (1978a). A model of teacher stress. *Educational Studies,* 4 (1), 1-6.

Kyriacou, C. and Sutcliffe, J. (1978b). Teacher stress: prevalence, sources, and symptoms. *British Journal of Educational Psychology,* (48) 159-167.

Kyriacou, C. and Sutcliffe, J. (1979a). A note on teacher stress and locus of control. *Journal of Occupational Psychology,* (52)227-228.

Kyriacou, C. and Sutcliffe, J. (1979b). Teacher stress and satisfaction. *Educational Research,* (21)89-96.

Lai, K. W. (2000). Health risks with teachers' computer use: Some New Zealand observations. *Journal of Information Technology in Teacher Education,* (9)303-318.

Lampert, M., and Ball, D. L. (1998). *Teaching, multimedia, and mathematics: investigation of real practice.* New York: Teachers College Press.

Lang, A., Bradley, SD., Chung, Y. and Lee, S. (2003). Where the mind meets the message: reflections on ten years of measuring psychological responses to media. *Journal of Broadcasting & Electronic Media,* 47.4: 650+. Questia. Retrieved on May 19, 2007 from http://www.questia.com/PM.qst?a=o&d=5002445720

Larson, D., Dutt-Doner, K. M. and Broyles, I. (2002). Don't ask; don't tell: a flawed approach to technology standards in higher education. *Journal of Information Technology for Teacher Education, (11)*123-141.

Lazarus, R. S., and Folkman, S. (1984). *Stress, appraisal, and coping.* New York: Springer.

Lazarus, R. S. (1963). *Personality and adjustment.* Englewood Cliffs, N.J.: Prentice-Hall.

Lazarus, R. S., and Launier, R. (1978). Stress-Related Transactions between Person and Environment. In L. A. Pervin and M. Lewis (eds), *Perspectives in interactional psychology* (pp: 287-327). New York; London: Plenum Press.

Lazarus, R. S. (1966). *Psychological stress and the coping process.* New York: McGraw-Hill.

Lazarus, R. S. (1991). *Emotion and adaptation.* New York and Oxford: Oxford UP.
Lazarus, R. S. (1995). Psychological stress in the workplace. In R. Crandall and P. L. Perrewe (eds.), *Occupational stress: handbook.* Washington: Taylor & Francis.
Lazarus, R. S. (2006). *Stress and emotion: a new synthesis.* New York: Springer.
Lazarus, R. S., and Monat, A. (1979). *Personality Prentice-Hall foundations of modern psychology series Foundations of modern psychology series.* (3rd / ed.). Englewood Cliffs; London: Prentice-Hall.
Lazarus, R. S., and Opton, E. (1967). *Personality: selected readings*: Penguin.
Lazarus, R. S. (1981). Comparison of two modes of stress management: Daily hassles and uplifts versus major life events. *Journal of Behavioural Medicine,* (4)1–39.
Lee, J., Hong, N. and Ling, N. (2002). An analysis of students' preparation for the virtual learning environment. *Internet and Higher Education (4)*231-242.
Lee, J. (2003). An analysis of the antecedents of organization-based self-esteem in two Korean banks. *The International Journal of Human Resource Management,* 14 (6) 1046-1066.
Leonard, A. (1984). *A study of stress in London secondary school teachers.* (Unpub.). PhD. Thesis. London: University of London.
Levi, L. (1965). The urinary output of adrenalin and noradrenalin during pleasant and unpleasant emotional states. *Psychosomatic Medicine,* 27, 80-85.
Levi, L. (1998). Preface: Stress in Organizations-Theoretical and Empirical Approaches. In C. L. Cooper (ed.), *Theories of organizational stress.* Oxford and New York: Oxford University Press.
Levenson, R. W. (1988). Emotion and the autonomic nervous system a prospectus for research on autonomic specificity. In H.L. Wagner (ed.), *Social Psy-chophysiology and Emotion Theory and Clinical Applications* (pp. 17-42.). Wiley: Hoboken, NJ.
Lewis, D. (1999). *Information overload: practical strategies for surviving in today's workplace.* London: Penguin Books.
Lewin. K. (1951). Frontiers in group dynamics. In D. Cartwright (Ed.). *Field theory in social science:* Selected theoretical papers by Kurt Lewin: 188-237. New York: Harper Torchbooks.
Lisetti, C. L., LeRouge, C. and Nasoz, F. (2002). The MAUI project: building multimodal affective user interfaces for everyone. American Association for Artificial Intelligence Retrieved on June 20, 2007 from http://www.cs.ucf.edu/~lisetti/articles/LisettiAAAI02.pdf
Liston-Smith, J. (2001). Information overload: Report from a masterclass at the CIPD HRD Conference, 3-5 April 2001. Retrieved on May 19, 2007 from http://www.isma.org.uk/stressnw/infover1.htm.
London, M. and Klimoski, R. J. (1975). A study of perceived job complexity. *Personnel Psychology, 28 (1)* 45-56.
Loveless, A. (2005). Challenge and change with information and communications technology in education: do we really mean it? *Technology Pedagogy and Education, (14)*277-307.
Lukoff, D. (2004). Navigating the mental health Internet, Lesson 7.1 Technostress. Spiritual Competency Resource Center. Retrieved on May 19, 2007 from http://www.virtualcs.com/nmhi/lesson7_1.html
Lumpe, AT., and Chambers, E. (2001). Assessing teachers' context beliefs about technology use. *Journal of Research on Technology in Education,* 34.1: 93+. Questia. Retrieved on May 19, 2007 from http://www.questia.com/PM.qst?a=o&d=5002430770.
Lundgren, U. P. (1972). *Frame factors and the teaching process: A contribution to curriculum theory and theory of teaching.* Stockholm: Almqvist and Wiksell.
Mandinach, E. B. and Cline, H. F. (1994). *Classroom dynamics: implementing a technology-based learning environment.* Hillsdale, N.J and Hove: Lawrence Erlbaum.
Mason, L. J. (1997a). Ergonomics of computer stress: stress education centre. Retrieved on May 19, 2007 from http://www.dstress.com/computer.htm.
Mason, L. J. (1997b). We are more overwhelmed, now! stress education center. Retrieved on May 19, 2007 from http://www.dstress.com/computer.htm.
Massoud, S. L. (1991). Computer attitudes and computer knowledge of adult students, *Journal of Educational Computing Research,* 7(3), 269-291.
Matthews, G. (2000). Levels of Transaction: A cognitive science framework for operator stress. In P. A. Hancock and P. A. Desmond (eds), *Stress, workload, and fatigue.* Mahwah, N.J. and London: Lawrence Erlbaum Associates.
Maudgalya, T., Wallace, S., Daraiseh, N. and Salem, S. (2006). Workplace stress factors and 'burnout' among information technology professionals: a systematic review. *Theoretical Issues in Ergonomics Science, 7 (3)* 285-297.

McGrath, J. E. (1976). Stress and behaviour in organizations. In M. Dunnette (ed.), *Handbook of Industrial Organizational Psychology.* Chicago: Rand McNally.

McIntyre, D. (2005). Bridging the gap between research and practice. *Cambridge Journal of Education, 35 (3)* 357-382.

McKenzie, B. K., Mims, N. G., Davidson, T. J., and Clay, M. N. (1996), Technostressed!!! coping strategies and future direction for teacher educators. *Technology and Teacher Education Annual,* 674-678.

McNair, D. M., Lorr, M., and Droppleman, L. F. (1981). *Manual for the profile of mood states.* San Diego, CA: Educational and Industrial Testing Service.

McNamara, S. (2000). *Stress in young people; what's new and what can we do?* London: Continuum.

McNamara, S. (2005). *Helping young people to beat stress.* London: Continuum.

Melamed, S., Fried, Y. and Froom, P. (2001). The interactive effect of chronic exposure to noise and job complexity on changes in blood pressure and job satisfaction: a longitudinal study of industrial employees. *Journal of Occupational Health Psychology, 6 (3)*182-195.

Mercola, J. (2003). Information overload. Retrieved on May 9, 2007 from http://www.mercola.com/2003/nov/12/information_overload.htm.

Merseth, K. K. and Lacey, C. A. (1993). Weaving stronger fabric: The pedagogical promise of hypermedia and case methods in teacher education. *Teaching and Teacher Education,* 9 (3) 283-299.

Merseth, K. K. (1996). Cases and case methods in teacher education. In J. Sikula (Ed.), *Handbook of research on teacher education* (2nd ed.). (pp. 722-744). New York: Macmillan.

Meyer, D. E. and Evans, J. E. (2001). Executive control of cognitive processes in task switching. *Journal of Educational Psychology,* 27 (4) 763-797.

Milstein, M. and Golaszewski, T. (1985). Effect of organizationally based and individually based stress management efforts in elementary school sittings. *Urban Education,* 19 (4) 389-409.

Monat, A. and Lazarus, R. S. (1977). *Stress and coping: an anthology.* New York; Guildford: Columbia University Press.

Moos, R. H. and Swindle, R. W. (1990). Person-Environment Transactions and the Stressor-Appraisal-Coping Process. *Psychological Inquiry,* 1 (1) 30-32.

Morgan, S. J. (2004). *Teacher stress in schools and colleges: a study of personal and institutional factors.* Liverpool: University of Liverpool.

Morgan, K., Morgan, M. and Hall, J. (2000). Psychological developments in high technology teaching and learning environments. *British Journal of Educational Technology, (31)*71-79.

Morrow, LM., Barnhart, S., and Rooyakkers, D. (2002). Integrating technology with the teaching of an early literacy course: the early literacy course described used many kinds of technology to improve teaching and learning. *The Reading Teacher,* 56.3: 218+. Questia. Retrieved on Mar 3, 2007 from http://www.questia.com/PM.qst?a=o&d=5000676447

Moyle, P. and Parkes, K. (1999). The effects of transition stress: a relocation study. *Journal of Organizational Behaviour,* (20)625-646.

Mughal, S. K. (2003). *Relations between personality work performance and stress in an occupational setting.* London: University of London.

Mumtaz, S. (2000a). Factors affecting teachers' use of information and communications technology: a review of the literature. *Journal of Information Technology for Teacher Education, (9)*319- 341.

Mumtaz, S. (2000b). *Using ICT in schools: a review of the literature on learning, teaching and software evaluation.* [Coventry]: Centre for New Technologies Research in Education University of Warwick.

Murray, B. (1998). data smog: newest culprit in brain drain (Vol. 2003): APA. Retrieved on May 9, 2007 from http://www.apa.org/monitor/mar98/smog.html.

National Center for Health Statistics. NCHS. Definition, serious psychological distress. Retrieved on June 24, 2007 from http://www.cdc.gov/nchs/datawh/nchsdefs/seriouspsydistress.htm.

Nelson, M. R. (2000). We have the information you want, but getting it will cost you: being hostage by information overload: ACM crossroads student magazine. Retrieved on May 9, 2007 from http://www.acm.org/crossroads/xrds1-1/mnelson.html.

Newman, K. (2003). Information overload-overcoming technostress. Retrieved on May 9, 2007 from http://www.istart.co.nz/index/HM20/AL21939/AR22224.

Nias, J. (1989). *Primary teachers talking: a study of teaching as work.* London: Routledge.

Nielsen, H. D., and Moos, R. H. (1978). Exploration and adjustment in high school classrooms: a study of person-environment fit. *Journal of Educational Research,* 72 (1) 52-57.

Nisan-Nelson, PD. (2001). Technology integration: a case of professional development. *Journal of Technology and Teacher Education,* 9.1: 83. Questia. Retrieved on May 9, 2007 from http://www.questia.com/PM.qst?a=o&d=5002403156

Norcia, V. D. (2002). *Technological complexity and ethical control.* IEEE Technology and society Magazine. Retrieved on March 20, 2007 from http://www.chemengr.ucsb.edu/~jinzhang/TAS_Norcia.pdf

Norusis, M. J. (1983). *SPSS x introductory statistics guide.* New York: McGraw-Hill.

Norusis, M. J. (2000), *SPSS 10.0 guide to data analysis.* Upper Saddle River, N.J.: Prentice Hall.

Office for National Statistics (ONS) (2007). Full-time nursery and primary and secondary school teachers: by sex: Social Trends 34, Retrieved on July 26, 2007 from http://www.statistics.gov.uk/STATBASE/ssdataset.asp?vlnk=7322Rubinstein, J. S.

Ogan, C., and Chung, D. (2003). Stressed out: a national study of women and men journalism and mass communication faculty, their uses of technology, and levels of professional and personal stress. *Journalism and Mass Communication Educator, (57)*352-368.

Oldham, G. R. and Gordon, B. I. (1999). Job complexity and employee substance use: the moderating effects of cognitive ability. *Journal of Health and Social Behavior,* 40 (3) 290-306.

Otero, V., Peressini, D., et al. (2005). Integrating technology into teacher education: a critical framework for implementing reform. *Journal of Teacher Education,* 56.1: 8+. Questia. Retrieved on March 20, 2007 from http://www.questia.com/PM.qst?a=o&d=5008307110.

Owens, S. R. (2005). *Understanding the effects of work stress on employee absence: a theoretical and empirical investigation.* London: University of London.

Palaigeorgiou, G. E., Siozos, P. D., Konstantakis, N. I., & Tsoukalas, I.A. (2005). A computer attitude scale for computer science freshmen and its educational implications. *Journal of Computer Assisted Learning* 21 (5), 330-342.

Papworth, M. (2003). *Stress busting.* London: Continuum.

Parkin, D. (1998). *Foreword.* In Department of Education, *Building an action plan: A sequel to the kit health and wellbeing at work,* Melbourne: Department of Education.

Patton, M. Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA and London: Sage Publications, Inc.

Patton, M. Q. (2002). *Qualitative evaluation and research methods* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Pecchinenda, A., and Smith, C. A. (1996). The affective significance of skin conductance activity during a difficult problem-solving task. *Cognition and Emotion, 10*(5), 481–503.

Perrewea, P. L., and Zellars, K. L. (1999). An examination of attributions and motions in the transactional approach to the organizational stress process. *Journal of Organizational Behaviour, (20)* 739-752

Preston, C., Cox, M. J., and Cox, K. M. J. (2000). *Teachers as Innovators: An evaluation of the motivation of teachers to use information and communications technologies.* Croydon: King's College London and Mirandanet.

Peterson, P. L., and Clark, C. M. (1978). Teachers' reports of their cognitive processes during teaching. *American Educational Research Journal, 15* (4), 555-565.

Pettegrew, L. S., and Wolf, G. (1982). Validating measuring of teacher stress. *American Educational Research Journal, 19* (3), 373-396.

Phelps, R. Hase, S., and Ellis, A. (2005). Competency, capability, complexity and computers: Exploring a new model for conceptualising end-user computer education. *British Journal of Educational Technology, 36,* 67-84.

Picard, R. W. (1997). *Affective computing.* Cambridge: MIT Press.

Picard, R. W. (2007). *Affective computing.* Retrieved June 20, 2007, from http://affect.media.mit.edu/areas.php?id=sensing.

Picard, R. W. (2001). *Affective medicine: Technology with emotional intelligence.* Retrieved on March 20, 2007 from MIT Web site: ftp://whitechapel.media.mit.edu/pub/tech-reports/TR-537.pdf.

Picard, R. W., and Klein, J. B. (2002). Computers that recognise and respond to user Emotion: Theoretical and practical implications. *Interacting with Computers, 14,* 141-169.

Picardi, A., Abeni, D., and Pasquini, P. (2001). Assessing psychological distress in patients with skin diseases: Reliability, validity and factor structure of the GHQ-12. *Journal of the European Academy of Dermatology and Venereology, 15*(5), 410-417.

Pineau, W. (2003). *The fitness fulcrum: A systematic exploration of managing teacher stress through exercise.* Retrieved on May 9, 2007, from http://scholar.google.com/scholar?hl=en&lr=&q=cache:xxfT_Z73eEgJ:www.edu.uleth.ca/masters/pdf/final_paper.pdf+%22suffer+from+the+effects+of+distress%E2%80%9D.+Pineau,+2003.

Pithers, R. T., and Rebecca, S. (1999). Person-environment fit and teacher stress. *Educational Research, 41*(1), 51-61.

Poole, C. E., and Denny, E. (2001, November). Technological change in the workplace: A statewide survey of community college library and learning resources personnel [Electronic version]. *College and Research Libraries*, 503-515. Retrieved on March 20, 2007 from http://www.ala.org/ala/acrl/acrlpubs/crljournal/backissues2001b/november01/poole.pdf.

Posen, D. B. (2000). *The fascinating history of stress theory.* Retrieved on May 7, 2007, from http://www.davidposen.com/pages/pricip/princip6.html.

Pratt, L. A., Dey, A. N., and Cohen, A. J. (2007). Characteristics of adults with serious psychological distress as measured by the K6 scale: United States, 2001-04. *Advance Data.* Retrieved on July 31, 2007, from http://www.cdc.gov/nchs/data/ad/ad382.pdf.

Prendinger, H., Mori, J., and Ishizuka, M. (2005). Using human physiology to evaluate subtle expressivity of a virtual quizmaster in a mathematical game. *International Journal of Human-Computer Studies*, 62, 231-245.

Preston, C. (2004). *Learning to use ICT in Classrooms: teachers' and trainers' perspectives: an evaluation of the English NOF ICT teacher training programme 1999-2003.* London, MirandaNet and the Teacher Training Agency. Retrieved on March 22, 2008, from www.mirandanet.ac.uk/tta

Pugliesi, K. (1999). Gender and work stress: Differential exposure and vulnerability. *Journal of Gender Culture and Health*, 4(2), 97-117.

Punch, K. F., and Tuettemann, E. (1990). Correlates of psychological distress among secondary school teachers. *British Educational Research Journal, 16*(4), 369-382.

Putnam, R. T., and Borko, H. (2000). What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher, 29*(1), 4-15.

Quick, J. C., Nelson, D. L., Quick, J. D., and Orman, D. K. (2001). An isomorphic theory of stress: The dynamics of person-environment fit. *Stress and Health, 17*, 147-157.

Rasmussen, J., and Mathiasen, H. (2004). The problem of complexity in education concerning teachers self-understanding and teachers use of laptop computers in education AERA Retrieved on June 8, 2007, from http://ccaerasig.com/papers/04/Ramussen-TheProblem.pdf.

Rauterberg, M. (1994). About the relationship between incongruity, complexity and information: Design implications for man-machine systems Retrieved on March 20, 2007 from http://citeseer.ist.psu.edu/cache/papers/cs/18912/http:zSzzSzwww.ipo.tue.nlzSzhomepageszSzmrauterbzSzpublicationszSzISI94paper.pdf/about-the-relationship-between.pdf.

Renshaw, K. (1997). Symptoms and causes of teacher burnout. *American Music Teacher, 46* (4), 57-58.

Repetti, R. L. (1993). Short-term effects of occupational stressors on daily mood and health complaints. *Health Psychology, 12* (2), 125-131.

Riegel, K. F., and Meacham, J. A. (1978). Dialectics, transaction, and Piaget's theory. In L. A. Pervin & M. Lewis (Eds.), *Perspectives in interactional psychology* (pp: 23-47). New York and London: Plenum Press.

Rintala, N. (2005). *Technological change and job redesign: Implications for the quality of working life; A qualitative case study into employee experiences during the digitalization of radio and television program production.* Unpublished doctoral dissertation, Helsinki University of Technology.

Robson, C. (2002). *Real world research: A resource for social scientists and practitioner-researchers.* (2nd ed.). Oxford: Blackwell.

Ronald, M., and Jason, N. (1994). Stress. In V. S. Ramachandran (Ed.), *Encyclopedia of Human Behavior* (Vol. 4, pp. 311-323). San Diego: Academic Press, Inc.

Roos, P. A., and Treiman, D. J. (1980). DOT scales for the 1970 census classification. In A. R. Miller, D. J. Treiman, P. S. Cain, & P. A. Roos (Eds.), *Work, jobs, and occupations: A critical review of the Dictionary of Occupational Titles* (pp: 336-389). Washington, DC: National Academy Press.

Rosen, L. D., and Weil, M. M. (1995). Computer availability, computer experience and technophobia among public school teachers. *Computers in Human Behavior, 11*, 9-31.

Ross, R. R., and Altmaier, E. M. (1993). *Intervention in occupational stress: A handbook of counseling for stress at work.* London: Sage Publications, Inc.

Rovai, A. P., and Childress, M. D. (2002-2003, Winter). Explaining and predicting resistance to computer anxiety reduction among teacher education students. *Journal of Research on Technology in Education, 35*(2), 226-235.

Rowe, M. B. (1974). Relation of wait-time and rewards to the development of language, logic, and fate control: Part 11—Rewards. *Journal of Research in Science Teaching, 11*(4), 291-308.

Rubinstein, J. S. Meyer, D. E. and Evans, J.E. (2001). Executive Control of Cognitive Processes in Task Switching. *Journal of Educational Psychology.* 27 (4) 763-797.

Rudow, B. (1999) Stress and burnout in European studies, issues, and research perspectives. In R. Vandenberghe & A. M. Huberman (Eds.), *Understanding and preventing teacher burnout: A sourcebook of international research and practice* (pp. 38-58). Cambridge: Cambridge University Press.

Ruff, J. (2002) *Information overload: Causes, symptoms and solutions.* (A Learning Innovations Laboratories Briefing). Boston, MA: Harvard Graduate School of Education.

Rush, A.J., Pincus, H.A., First, M.B. *et al.*, (2000). *Handbook of Psychiatric Measures*, American Psychiatric Association, Washington, DC.

Russell, G., and Bradley, G. (1997). Teachers' computer anxiety: Implications for professional development. *Education and Information Technologies, 2*, 17-30.

Rutkowska, J., and Crook, C. (1987). *Computers, cognition and development : Issues for psychology and education.* Chichester: Wiley.

Ryska, T. A. (2002). Leadership styles and occupational stress among college athletic directors: The moderating effect of program goals. *The Journal of Psychology, 136*, 195-213.

Sabers, D. S., Cushing, K. S., and Berliner, D. C. (1991). Differences among teachers in a task characterized by simultaneity, multidimensionality, and immediacy. *American Educational Research Journal, 28*(1), 63-88.

Sanderlin, T. K. (2004). Managing technostress in the organizational environment: Symptoms and solutions. *Annals of the American Psychotherapy Association, 7*(1). Retrieved June 8, 2007, from http://www.questia.com/PM.qst?a=o&d=5006751647.

Sandholtz, J. H., Ringstaff, C., and Dwyer, D. C. (1997). *Teaching with technology: Creating student-centered classrooms.* New York: Teachers College Press.

Salvo, V. D., Lubbers, C., Rossi, A. M., and Lewis, J. (1995). Unstructured perception of work-related stress: An exploratory qualitative study. In R. Crandall & P. L. Perrewe (Eds.), *Occupational stress: Handbook.* Washington: Taylor & Francis

Sarantakos, S. (2005). *Social research.* Basingstoke, Palgrave Macmillan.

Schacter, J. (1999). *The impact of education technology on student achievement; What the most current research has to say.* Retrieved June 8, 2007, from Milken Exchange on Education Technology website: http://www.mff.org/publications/publications.taf?page=161.

Schaubroeck, J. (1999). Should the Subjective Be the Objective? On Studying Mental Processes, Coping Behavior, and Actual Exposures in Organizational Stress Research. *Journal of Organizational Behavior*, 20 (5) 753-760.

Scheirer, J., Fernandez, R., Klein, J., and Picard, R. W. (2002). Frustrating the user on purpose: A step toward building an affective computer. *Interacting with Computers, 14*(2), 93-118

Schmidt, S., and Harald, W. (2000). Electrodermal activity (EDA) State-of-the-art measurement and techniques for parapsychological purposes. *Journal of Parapsychology, 64*(2) 139. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5001793370.

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action.* New York: Basic Books.

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions.* San Francisco: Jossey-Bass.

Schön, D. A. (1991). *The reflective practitioner: How professionals think in action.* Aldershot: Avebury.

Schön, D. A. (1995). *The reflective practitioner: How professionals think in action.* Aldershot: Arena

Selye, H. (1956). *The stress of life.* New York: McGraw-Hill.

Selye, H. (1974). *Stress without distress.* Philadelphia: Lippincott.

Selye, H. (1975), Confusion and controversy in the stress field. *Journal of Human Stress, 1*, 37-44.

Selye, H. (1976). *Stress in health and disease.* Boston, MA and London: Butterworth.

Selye, H. (1983). The stress concept: Past, present, and future. In C. L. Cooper (Ed.), *Stress research.* Toronto: John Wiley & Sons.

Selye, H. (1991). History and present status of the stress concept. In A. Monat & R. S. Lazarus (Eds.), *Stress and coping* (pp. 21-35). New York: Columbia University Press.

Semmer, N, and Dunckel, H. (1991). Stressbezogene arbeitsanalyse. In S. Greif, E, Bamberg, & N, Semmer (Eds.), *Psychischer Stress am Arhettsplatz* (pp. 57-90). Goettingen: Hogrefe.

Sethi, V., King, R., and Quick, J. (2004). What causes stress in information system professionals? *Communication of the ACM, 47*(3), 99–102.

Sethi, A. S., Caro, D. H. J., and Schuler, R. S. (1987). *Strategic management of technostress in an information society.* Lewiston: Hogrefe.

Shamoail, E. (2005). *Teachers' perceptions and experiences in adopting "Blackboard" computer program in a Victorian secondary school: A case study.* Victoria, Australia: Victoria University Press.

Sharif, B. (2000). Understanding and managing job stress: A vital dimension of workplace violence prevention. *International Electronic Journal of Health Education, 3*(2), 107-116.

Shaw, J. D., and Gupta, N. (2004). Job complexity, performance, and well-being: When does supplies-values fit matter?' *Personnel Psychology, 57*(4), 847-879.

Shenk, D. (1997). *Data smog: Surviving the information glut.* San Francisco: HarperEdge.

Shepherd, S. S. (2004). *Relationships between computer skills and technostress: How does this affect me?* Paper presented at the Association of Small Computer Users in Education (ASCUE) Conference, Myrtle Beach, SC.

Shulman, L. S., and Carey, N. B. (1984). Psychology and the limitations of individual rationality: Implications for the study of reasoning and civility. *Review of Educational Research, 54*(4), 501-524.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4 – 14.

Sieber, J. (1992). *Planning ethically responsible research.* London: Sage Publications, Inc.

Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. *Journal of Occupational Health Psychology, 1,* 27–43.

Simco, N. P. (1995). Using activity analysis to investigate primary classroom environments. *British Educational Research Journal, 21,* 49-60.

Simco, N., and Warin, J. (1997). Validity in image-based research: An elaborated illustration of the issues. *British Educational Research Journal, 23*(5), 661-673.

Sime, W. (2007). *Psychophysiology of stress according to Hans Selye.* Retrieved August 5, 2007, from http://cehs.unl.edu/stress/resources/hansselye.html.

Sinclair, M. (2003, October 16-18), *Reflections on complexity theory and technology: Experiences in three mathematics lab-classrooms.* Paper presented at the Science and Educational Research Conference, Edmonton, Canada.

Smilansky, J. (1984). External and internal correlates of teachers' satisfaction and willingness to report stress. *British Journal of Educational Psychology, 54,* 84–92.

Smith B., Caputi P. and Rawstorne P. (2000) Differentiating computer experience and attitudes toward computers: an empirical investigation. *Computers in Human Behaviour* 16, 59-81.

Smith, E. (2005). *An exploration of psychological, behavioural and physiological features of teacher stress in the primary classroom.* Unpublished master's thesis, University of London, London.

Smith, D., and Milstein, M. N. (1984). Stress and teachers: Old wine in new bottles. *Urban Education, 19,* 39-51.

Smith, L. M., and Geoffrey, W. (1968). *The complexities of an urban classroom: An analysis toward a general theory of teaching.* New York: Holt Rinehart and Winston.

Smylie, M. A. (1989). Teachers' views of the effectiveness of sources of learning to teach. *The Elementary School Journal, 89*(5), 543-558.

Sonnentag, S., Brodbeck, F. C., Heinbokel, T., and Stolte, W. (1994). Stressor-burnout relationship in software development teams. *Journal of Occupational and Organizational Psychology, 67*(4), 327-341.

Speier, C., and Frese, M. (1997). Generalized self-efficacy as a mediator and moderator between control and complexity at work and personal initiative: A longitudinal field study in East Germany. *Human Performance, 10*(2), 171-192.

Spicer, J. (1997). Systems Analysis of Stress and Coping: A Testing Proposition, *Journal of Health Psychology,* 2, 167-170.

Spielberger, C. D., and Reheiser, E. C. (1995). Measuring occupational stress: The job stress survey. In R. Crandall & P. L. Perrewe (Eds.), *Occupational stress: Handbook.* Washington: Taylor & Francis.

Spielberger, C. D., Vegg, P. R., and Wasala, C. F. (2003). Occupational stress: Job pressures and lack of support. In J. C. Quick & L. E. Tetrick (Eds.), *Handbook of occupational health psychology.* Washington, D.C.: American Psychological Association.

Spiro, R. J., Coulson, R. L., Feltovich, P. J., and Anderson, D. K. (1988). Cognitive flexibility theory: Advanced knowledge acquisition in ill-structured domains. In *Tenth Annual Conference of the Cognitive Science Society* (pp. 375-383). Hillsdale, NJ: Erlbaum

Spiro, R. J., Feltovich, P. J., Coulson, R. L., and Anderson, D. K. (1989). Multiple analogies for complex concepts: Antidotes for analogy-induced misconception in advanced knowledge acquisition. In S. Vosniadou & *A.* Ortony (Eds.), *Similarity and analogical reasoning* (pp. 498-531). Cambridge, England: Cambridge University Press.

Spiro, R. J., and Jehng, J. (1990). Cognitive flexibility and hypertext: Theory and technology for the nonlinear and multidimensional traversal of complex subject matter. In D. Nix & R. Spiro (Eds.), *Cognition, education, and multimedia: Exploring ideas in high technology* (pp. 164-205). Hillsdale, NJ: Erlbaum.

Staal, M. A. (2004). *Stress, cognition, and human performance: A literature review and conceptual framework.* Retrieved May 9, 2007, from Ames Research Centre website: http://humanfactors.arc.nasa.gov/flightcognition/Publications/IH_054_Staal.pdf

Stahl, S. M., Grim, C. E., Donald, C., and Neikirk, H. J. (1975). A model for the social sciences and medicine: The case for hypertension. *Social Science and Medicine, 9,* 31-38.

Stone, A. A., and Neale, J. M. (1982). Development of a methodology for assessing daily experiences. In A. Baum & J. E. Singer (Eds.), *Advances in environmental psychology* (Vol. 4: Environment and health, pp. 49-83). Hillsdale, NJ: Erlbaum.

Sugar, W., Crawley, F., and Fine, B. (2004). Examining teachers' decisions to adopt new technology. *Educational Technology and Society,* 7 (4), 201-213.

Sutherland, V. J., and Cooper, C. L. (1990). *Understanding stress: A psychological perspective for health professionals.* London: Chapman and Hall.

Sutton, R., and Kahn, R. L. (1986). Prediction, understanding, and control as antidotes to organisational stress. In J. Lorsch (Ed.), *Handbook of organizational behaviour.* Englewood Cliffs, NJ: Prentice-Hall.

Sykes, G., and Bird, T. (1992). Teacher education and the case idea. *Review of Research in Education, 18,* 457-521.

TCW (2007). *The Transactional Model of Stress and Coping,* Retrieved August 28, 2007, from http://www.tcw.utwente.nl/theorieenoverzicht/Theory%20clusters/Health%20Communication/transactional_model_of_stress_and_coping.doc/

Tennen, H., Affleck, G., Armeli, S., and Carney, M. A. (2000). A daily process approach to coping: Linking theory research and practice. *American Psychologist, 55*(6), 626-636.

Tepas, D. I., and Price, J. M. (2001). What is stress and what is fatigue? In P. A. Hancock & P. A. Desmond (Eds.), *Stress, workload, and fatigue* (pp. 607-622). Mahwah, NJ: Lawrence Erlbaum Associates.

Tetrick, L. E., and LaRocco, J. M. (1987). Understanding, prediction, and control as moderators of the relationships between perceived stress, satisfaction, and psychological well-being. *Journal of Applied Psychology, 72,* 538-542.

The British Educational Research Association. (2003). *Code of ethics.* Retrieved June 21, 2007, from http://www.ioe.ac.uk/doctoralschool/BERA.pdf.

Thoits, P. A. (1982). Conceptual, methodological, and theoretical problems in studying social support as a buffer against life stress. *Journal of Health and Social Behaviour, 23* (2), 145-159.

Thomas, C., and Neylan, M. D. (1998). Hans Selye and the field of stress research [Electronic Version]. *Journal of Neuropsychiatry and Clinical Neurosciences, 10,* 230-231.

Thompson, S. C. (1981). Will it hurt less if I can control it? A complex answer to a simple question. *Psychological Bulletin, 90*(1), 89–101.

Tijerina, L., Kiger, S., Wierwille, W., Rockwell, T., Kantowitz, B., Bittner, J. A., et al. (1996). *Final report supplement Task 1: Task analysis data and protocols review.* Retrieved March 3, 2007, from http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/lq01!.pdf#search='Heavy%20Vehicle%20Driver%20Workload

Tikunoff, W. J., and Ward, B. A. (1983). Collaborative research on teaching. *The Elementary School Journal, 83*(4), 453-468.

Toffler, A. (1970). *Future shock.* London: Bodley Head.

Toffler, A. (1981). *The Third Wave*. London: Pan in association with Collins.

Towndrow, P. (2005). Teachers as digital task designers: An agenda for research and professional development. *Journal of Curriculum Studies, 37*, 507-524.

Travers, C., and Cooper, C. (1990), *Survey on occupational stress among teachers in the United Kingdom*. Manchester: Manchester University Institute of Science and Technology.

Travers, C. J., and Cooper, C. L. (1996). *Teachers under pressure: Stress in the teaching profession.* London: Routledge.

Trendall, C. (1989). Stress in teaching and teacher effectiveness: A study of teachers across mainstream and special education, *Educational Research, 31*(1), 52–58.

Trimmel, M., Meixner-Pendleton, M., and Haring, S. (2003). Stress response caused by system response time when searching for information on the Internet. Retrieved July 13, 2007, from http://www.questia.com/PM.qst?a=o&d=5002089891.

Trotter, A. (1999). Preparing teachers for the digital age [Electronic Version]. *Education Week, 19*, 37- 43.

Turner, R. M. (2000). *Stress amongst secondary school teachers: The management of stress and staff coping strategies in a particular setting.* Bristol: University of Bristol.

Van Der Linde, C. H. (2000). The teacher's stress and its implications for the school as an organization: How can TQM help? *Education, 121*(2), 375. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5001182946.

Vandenberghe, R., and Huberman, A. M. (1999). *Understanding and preventing teacher burnout: A sourcebook of international research and practice.* Cambridge: Cambridge University Press.

Voakes, P. S., Beam, R. A., and Ogan, C. (2003). The impact of technological change on journalism education: A survey of faculty and administrators. *Journalism and Mass Communication Educator, 57*(4), 318-334.

Wang, B. K., and Shu, Q. (2005). Computer-related technostress in China. *Communication of the ACM, 48*, 77-81.

Ward, R. D., and Marsden, P. H. (2003). Physiological responses to different Web page designs. *International Journal of Human-Computer Studies*, 59 (1-2) 199-212.

Warr, P. (1987). *Work, unemployment, and mental health.* Oxford: Clarendon.

Watkins, C., University of London. Institute of Education and Association of Teachers and Lecturers. (2000), Managing classroom behaviour : from research to diagnosis. London: Institute of Education University of London in association with Association of Teachers and Lecturers

Watson, D., and Pennebaker, J. W. (1989). Health complaints, stress, and distress: Exploring the central role of negative affectivity. *Psychological Review, 96*, 234-254.

Watson, D., Clark, L.A. and Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*. 54 (6) 1063- 1070.

Webb, M., and Cox, M., (2004) A review of pedagogy related to information and communications technology. *Technology, Pedagogy and Education.* 13 (3) 235-286

Weil, M. and Rosen, L. (1997). *TechnoStress coping with technology @ work @ home @ play.* New York: John Wiley & Sons, Inc.

Weil, M. and Rosen, L. (1998). *Technology causes stress at home, work.* New York, NY: American Business Journals Inc.

Weil, M., and Rosen, L. (2000). *Results of our 49-month study of business attitudes show clerical/support staff, managers and executives using more technology at work and at home and becoming more hesitant toward new technology.* Retrieved March 3, 2007, from http://www.technostress.com/busstudy2000.htm.

Whitely, B. E. (1996). Gender differences in computer-related attitudes: It depends on what you ask. *Computers in Human Behavior, 12*, 275-89

Wiburg, K. (1995), Integrate learning system: What does the research say? *The Computing Teacher, 22*, 7-10.

Wildstrom, S. (2000, July 17). Can Oxygen Turn Sci-Fi into Reality? [Electronic Version]. *BusinessWeek.*

Wilkins K., and Beaudet, M. P. (1998). Work stress and health [Electronic Version]. *Health Reports, 10*, 47-62.

Williams, M., and Gersch, I. (2004). Teaching in mainstream and special schools: Are the stresses similar or different? *British Journal of Special Education, (31)* 157-162 .

Willis, J., and Cifuentes, L. (2005). Training teachers to integrate technology into the classroom curriculum: Online versus face-to-face course delivery. *Journal of Technology and Teacher Education, 13*(1), 43. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5009214005.

Wilson, B., and Kyriacou, S. (1996). *The whirlwind continues: Users perspective of mental health in words and pictures*. London: Ethnic Communities Oral History Project.

Wilson, G. M. (2001). Psychophysiological indicators of the impact of media quality on users. *Proceedings of CHI 2001 Doctoral Consortium*, Seattle, WA, USA: ACM Press, 95-96.

Wilson, G. M., and Sasse, M. A. (2000). The head or the heart? Measuring the impact of media quality. In Extended Abstracts of *CHI*, The Hague, Netherlands: ACM Press, 117-118.

Wilson, G. M., and Sasse, M. A. (2000a). Investigating the impact of audio degradations on users: Subjective vs. objective assessment methods. In C. Paris, N. Ozkan, S. Howard, & S. Lu (Eds.), *Proceedings of OZCHI 2000: Interfacing Reality in the New Millennium*, December 4–8, Sydney, Australia. Retrieved June 20, 2007, from http://www.cs.ucl.ac.uk/staff/a.sasse/ozchi.pdf.

Wilson, G. M., and Sasse, M. A. (2000b), Listen to your heart rate: Counting the cost of media quality. In A. Paiva (Ed.), *Affective interactions-Towards a new generation of computer interfaces* (pp. 9-20).

Wilson, G. M., and Allanson, J. (2001). The role of electrophysiology in human computer interaction. In J. Vanderdonckt, A. Blandford, and A. Derycke (Eds.), *Proceedings of IHM-HCI 2001*, September 10-14, Lille, France, 251-252.

Wilson, V. (2002). *Feeling the strain; An overview of the literature on teachers' stress.* Retrieved May 9, 2007, from The Scottish Council for Research in Education (SCRE) website: http://www.scre.ac.uk/resreport/pdf/109.pdf.

Wilson, V., and Hall, J. (2002). Running twice as fast? A review of the research literature on teachers' stress. *Scottish Educational Review, 34*(1), 175-187.

Winkle, V.W. (1998). *Information overload: Fighting data asphyxiation is difficult but possible.* Retrieved March 3, 2007, from http://www.computerbits.com/archive/1998/0200/infoload.html

Winnans, C., and Brown, D. S. (1992). Some factors affecting elementary teachers' use of computers. *Computing in Education, 18*, 301-309.

Wittrock, M. C., and American Educational Research Association. (1986). *Handbook of research on teaching*. (3rd ed.). New York and London: Macmillan.

Wolf, S., and Wolff, H. G. (1943). *Human gastric function*. New York: Oxford University Press.

Woods, P. (1986). *Inside schools: Ethnography in educational research*. London: Routledge & Kegan Paul.

Woods, D. D. (2002). Steering the reverberations of technology change on fields of practice: Laws that govern cognitive work. *Proceedings of the 24th Annual Meeting of the Cognitive Science Society*.

World Health Organization. (2004). *Health and work survey*. Retrieved June 27, 2007, from http://www.workhealth.org/UCLA%20OHP%20class%202004/GHQ%20and%20scoring.pdf

Wozney, L., Vivek V., and Abrami, P. C. (2006). Implementing computer technologies: Teachers' perceptions and practices. *Journal of Technology and Teacher Education, 14*(1), 173. Retrieved March 3, 2007, from http://www.questia.com/PM.qst?a=o&d=5014857465.

Wragg, E. C. (1994). *An introduction to classroom observation*. London, Routledge.

Wright, M., and Custer, R. (1998). Why they enjoy teaching: The motivation of outstanding technology teachers. *Journal of Technology Education, 9* (2), 60-77.

Xie, J. L., and Johns, G. (1995). Job scope and stress: Can job scope be too high? *Academy of Management Journal*, (38)1288-1309.

Ya-Ming, S. (2007) Investigating the sources of teachers' instructional technology use through the decomposed theory of planned behavior. *Journal of Educational Computing Research*, 36 (4), 425-453

Yang, H., Mohamed, D., and Beyerbach, B. (1999). An investigation of computer anxiety among vocational technical teachers. *Journal of Industrial Teacher Education, 37*(1), 64-81.

Yinger, R. (1979). Routines in teacher planning. *Theory into Practice, 18*(3), 163-169.

Younghusband, L., Garlie, N., and Church, E. (2003). *High School Teacher Stress in Newfoundland.* Canada International Conference on Education, Hawaii. Retrieved May 9, 2007, from http://www.hiceducation.org/Edu_Proceedings/Lynda%20Younghusband.pdf.

Zhao, Y., and Bryant, F. L. (2006) Can teacher technology integration training alone lead to high levels of technology integration? A qualitative look at teachers' technology integration after state mandated technology training. *Electronic Journal for the Integration of Technology in Education*, 5. 53-62.

# APPENDIXES

## Appendix A: The open-ended questionnaire

**Technostress Questionnaire**
Al-Fudail Mohammed
Institute of education
University of London

---

This questionnaire is intended to collate your views on technostress.

**Your details**

**Name:** ................................................
**Course:** ..............................................
**Date:** ..................................................

**Your views**

1. What information and communication technology (ICT) do you use at home and at work?

| | |
|---|---|
| .................................. | ...................................... |
| .................................. | ...................................... |
| .................................. | ...................................... |

2. Do you feel that the stress or complexity in your life are primarily increased or decreased by these technologies?

.............................................................................................
.............................................................................................
.............................................................................................

3. If technologies cause stress, what sorts of stress do they cause?

.............................................................................................
.............................................................................................

4. If technologies reduce stress, what sorts of stress do they reduce?

.............................................................................................
.............................................................................................

5. If technologies increase complexity in your life, what sort of complexity is this?

................................................................................
................................................................................
................................................................................

6. If technologies reduce complexity in your life, what sort of complexity do they reduce?

................................................................................
................................................................................
................................................................................

7. If technologies cause stress or complexity, how do you cope with this?

................................................................................
................................................................................
................................................................................

8. How do you think one could measure the influence of techno-stress and complexity in people's lives?

................................................................................
................................................................................
................................................................................

9. Please comment on this questionnaire; e.g. Was it easy /clear/ interesting to complete?

................................................................................

................................................................................

10. How long did it take?

................................................................................

*If you wish to receive a paper report on the questionnaire's results, which address should this be sent to?
.........................................................................................
.........

## Appendix B: The second preliminary questionnaire

**The paramount objective of the questionnaire is to obtain data aimed at understanding the effect of technology related stress and its impact on teachers work.**
**The study is aiming to investigate the following:**

**"To what extent does stress caused by increasing use of technology affect teacher's work? "**

**The research questions are**

1- **Are symptoms such as the following experienced by the users of technology?**

**Physical symptoms; Cognitive symptoms; Affective symptoms; Behavioural symptoms**

2- **Are factors such as the following related to TechnoStress (technology-related stress)?**

**Complexity of technology; Information overload; Interruption; Multi-tasking; Software errors/hardware errors**

3- **Do factors such as the following associated with the level of stress?**

**Age; Gender; Time of using technology; Users experience and training; Attitude towards technology**

4- **How do teachers cope with technostress in the classroom?**

**Many thanks**

**TechnoStress Questionnaire**

Al-Fudail Mohammed
Institute of education
University of London

---

- **This questionnaire is intended to collate your views on technostress. "Technostress is any negative impact on attitudes, thoughts, behaviours, or body physiology that is caused either directly or indirectly by technology"** (Weil, M. & Rosen, L.1997)
- Through this questionnaire, I hope to learn about:

  1. Your experience of technology-related stress.

  2. Your experience of symptoms & causes of Technostress.

  3. Factors causing stress, such as life events, daily hassles, and individual's perceived stress

  4. Technolgy-related stress and coping.

- The information will help me to investigate whether there is any relationship between the increasing use of technology and stress, as well as effects on teachers' work?

- The questionnaire is adapted from [ (Kirsh,D. 2000), (Kupersmith, J 1998),(Weil,M & Rosen, L 1997),(Hudiburg, R 2003,online research), (Luntz RCs, 1997), (World Health Organization (WHO) 2001-health and work survey-) and (social interaction and technology use questionnaire 2000)]

**Your answers will be kept confidential, Thank you**

## Your details

**1. Gender:** ☐ Male ☐ Female

**2. Please indicate your highest level of education........................**

**3. AGE:** ☐18-25 ☐26-35 ☐36-50 ☐51 or older

**4. What is your current marital status?**

☐ Married or Cohabiting ☐ Separated ☐ Divorced ☐ Widowed ☐ Never Married

**5. Date:.................................**

## Attitude towards technology

**Q6. Do you - regarding technology- consider your self as .... (tick one)?**

☐ Love technology; view it as fun and challenging.
☐ Do not think technology is fun and prefer to wait until a new technology is proven before trying it.
☐ Avoid technology.
☐ Do not love technology, but have to use it.

**Select by ticking (√) the one response for each question that comes closest to your experience.**

| | **0** | **Less than 1h** | **1-3 h** | **4-6 h** | **More than 6h** | |
|---|---|---|---|---|---|---|
| 7. On average, how many hours a day do you use technology? | | | | | | |
| 8. Of these hours, how many are used for academic activities? | | | | | | |
| 9. How many are used for other activities? | | | | | | |
| 10. How many hours a day do you spend using a computer? | | | | | | |

**Q11. What kind of technology do you use in the school?**

☐ Computer ☐ Video/TV

☐ Internet ☐ Audio devices

☐ Copy machine ☐ Mobile

☐ Printer ☐ Other please specify.......................................................

# Technology-related stress

| |
|---|
| ***It will help if in answering these questions you keep in mind technological devices such as: TV, Computers & Internet, Mobiles, audio & visual devices...etc*** |

**Q 12.Do you think that using technology is...?**

☐1 - Easy because technological devices are simple

☐2 - Easy because I've learned about the technology I use

☐3 - Difficult because technological devices are complicated

☐4 -Difficult because I've not learned about the technology I use

☐5 - 1 & 2

☐6 - 3 & 4

☐ 7. No idea

**Q 13.Do you think that the problem of technostress (Technology-related stress) is..?**

☐ Not serious ☐ Serious ☐ Very serious ☐ No idea

**Q 14. During the <u>LAST MONTH</u>, have you felt stressed because of any technological devices?**

☐ Yes please specify....................................

☐ No

**Q 15. Has your level of technostress....?**

☐ Decreased ☐ Not changed much ☐ Increased ☐ No idea

# Symptoms & Causes of Technostress

***It will help if in answering these questions you keep in mind technological devices such as: TV, Computer & Internet, Mobile, audio & visual devices...etc***

**Please answer the questions below by clicking/ticking a box in front of the alternatives for each question.**

**What are the symptoms arising from stress caused by technology for you? Indicate any symptoms in each categories by clicking the box in front of the symptoms?**

**16. Physical symptoms:**

- ☐ Muscle tension
- ☐ Rapid heartbeat
- ☐ Headaches
- ☐ None of them
- ☐ Other, please specify.........................................

**17. Cognitive symptoms:**

- ☐ Mental fatigue
- ☐ Inability to concentrate
- ☐ Poor judgment
- ☐ None of them
- ☐ Other, please specify.........................................

**18. Affective symptoms:**

- ☐ Anxiety
- ☐ Depression
- ☐ Bad temper
- ☐ None of them

- ☐ Other, please specify.........................................

**19. Behavioral symptoms:**

- ☐ Avoidance
- ☐ Withdrawal
- ☐ Insomnia (sleeplessness)
- ☐ None of them
- ☐ Other, please specify.........................................

**20. Other, symptoms please specify.........................................**

.................................................................................

**Q21. What are the main causes of technostress for you? Check by clicking/ticking a box in front of the question?**

- ☐ Information overload (incase of computer & Internet)
- ☐ more work required
- ☐ new learning required
- ☐ more demands
- ☐ too much change
- ☐ technology problems, or deficiency
- ☐ Networking problems (incase of computer & the Internet)
- ☐ Security issues (viruses, authentication, etc.) (incase of computer & the Internet)
- ☐ Application software (word processors, etc.) (incase of computer & the Internet)
- ☐ Web sites (in case of computers & the Internet)
- ☐ Complexity
- ☐ Multi–task (using several technological devices at the same time or moving from one to another (e.g. mobile and computer)?
- ☐ Other, please specify.........................................................

**Select (√ ) the one response for each question that comes closest to your experience.**

| | strongly support | somewhat support | somewhat oppose | strongly oppose | Don't know |
|---|---|---|---|---|---|
| Q22. Do you think that complexity of life increases because of technology? | | | | | |
| Q23. Do you think that nowadays technological devices are much complicated than the old technological tools? | | | | | |

**Q24. In general, do you feel that you will control the change of the technology in the future or will the change control you?**

☐ I feel I will control the change ☐ I feel I will not

**Q25. Do you think future technological breakthroughs are going to leave you with more free time or less free time?**

☐ More free time ☐ Less free time

**Q26. Do you think the increasing use of technologies will increase stress in the future?**

☐ Yes ☐ No ☐ may be

**Q27. Do you think technologies in the future will make the life more complicated or less complicated?**

☐ More complicated ☐ Less complicated

**Q28. How do you cope with Technostress?**

..........................................................................................................................................................
..........................................................................................................................................................
..........................................................................................................................................................

*Please comment on this Questionnaire; e.g. Was it easy / interesting to complete?

........................................................................................................

**How long did it take?..............................................................................

***If you wish to receive a paper report on the questionnaire's results, which address should this be sent to?

..............................................................................

**Many thanks**

## Appendix C: Interviewing 11 practising teachers

**(1)**

It depends on how the technology is used, if the students use the technology at discover and learn by playing like they would when they were a little children there is no stress and it become a fun it's a game it is enjoyable and the teachers there just to help them to play and learned, there were produceful things like tiny camera or digital camera, computer; it is only when technology is imposed artificially in a logic process then it become stressful When I taught media myself, for seven years we used radio technology camera film moving cinema television and it never caused any stress atoll because we did it as fun as ply as enjoyments.

**(2)**

Stress-less ... for me ... because I like technology ... students love technology ... and then I can communicate through technology with them ... and ... and they have something to do that is immediate and easy, and of course you have to plan what you are going to do, but I think for me it is easy to do that. I love it. But let me tell you something that is true... the first time I had to go with primary students to ... I had taught many teachers how to use computers, but when I had to go when I had to go by the first time I was really stress ... But let me tell you because my group was very crazy and I was ... he he ... I was afraid that they were crazy in the classroom with the computers ... but then later I discovered they were not mad, in fact they were more calmed while we were working there and ... we could enjoy the time there ... even though we had some fights some fights yes because we had to negotiate what to do with the computers and they wanted to play ... I general it is less stress for me
The task is different, not a reutilised activity. It is not the same task, even if you teach the same subject.
When there is a problem, you need to research ... deduct ... what happened.

**(3)**

It depends where the equipment works or not, let me say it is a big question ah, because often I find it high liable even using a program that I thought. Sometimes they just don't work or they work one day and they do not work the next day which make me that kind of user I can't relay on that.

**(4)**

It might if I don't practise I take it as stressful but ones you practise it and know how to do it then it will be easy'

**(5)**

Sometimes in my teaching it will be more difficult because I have some problems to deal with equipment, computer and PowerPoint and other things in my case it will be part of stress. Because I have to learn how to do it

**(6)**

I am not a side with technology but it annoyed me and if it annoyed I am stress

**(7)**

It depends on the way ... I already use computer. usually I go to computer *template* my session and exercise ... put all computers on organise every thing ... give the student a sheet of paper with information of how they should do it then in these cases don't get stress atoll ... but if I go and log in computer ... and something goes wrong in this case you get stress ...

**(8)**

It wouldn't make teaching stressful but it will make the preparation very stressful ... when you teaching in the classroom the most problematic thing when the technology doesn't work and in that it is when you get stress

**(9)**

Using technology doesn't make me stress at all ... some times it is stressful but generally I don't get stress at all.

**(10)**

... in some way is more and in some way is less I guess is the answer ... I think the main strategies is not being initially confident that the technology will work and do what you want it to do, but if it's don what you want it to do then it takes a lot of stress away partly it takes the littlie bit of weight from you

**(11)**

Depends on the level of the teacher knowledge of technology if the teacher happy with the technology, then that is fine, it could be an effort, but if the teacher is uncertain in herself it will make her situation very stressful.

# Appendix D: The main questionnaire

## TechnoStress Questionnaire

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- This questionnaire is intended to collate your views on technostress. ''Technostress is any negative impact on attitudes, thoughts, behaviours, or body physiology that is caused either directly or indirectly by technology'' (Weil, M. & Rosen, L.1997)
- Through this questionnaire, I hope to learn about:
    1. Your experience of technology-related stress (Technostress).
    2. Your experience of symptoms & causes of Technostress.
    3. Factors causing stress, such as life events, and individual's perceived stress
    4. Technostress and coping.
    5. Solutions to solve the problem of technostress in teaching.
- The information will help me to investigate whether there is any relationship between the use of technology and stress?
- The questionnaire was adapted from [ (Kirsh,D. 2000), (Kupersmith, J 1998),(Weil,M & Rosen, L 1997),(Hudiburg, 1996), (Luntz RCs, 1997), (World Health Organization (WHO) 2001-health and work survey-) and (social interaction and technology use questionnaire 2000)]

**Your answers will be kept confidential, Thank you**

## Attitude towards technology

**Q1. What kind of technology do you use in the school?**

- ☐ Computer ☐ Video/TV
- ☐ Internet ☐ Audio devices
- ☐ Copy machine ☐ Mobile
- ☐ Printer ☐ Other please specify…………………………………………………

**Q2. Do you - regarding technology- consider your self as …. (tick one)?**

- ☐ Love technology; view it as fun and challenging.
- ☐ Do not think technology is fun and prefer to wait until a new technology is proven before trying it.
- ☐ Avoid technology.
- ☐ Do not love technology, but have to use it.

**Q. Select by ticking (√) the one response for each question that comes closest to your experience.**

| | 0 | Less than 1h | 1-3 h | 4-6 h | More than 6h |
|---|---|---|---|---|---|
| 3. On average, how many hours a day do you use technology? | | | | | |
| 4. Of these hours, how many are used for academic activities? | | | | | |
| 5. How many are used for other activities? | | | | | |

# Technology-related stress

***It will help if in answering these questions you keep in mind technological devices such as: TV, Computers & Internet, Mobiles, audio & visual devices...etc***

**Q 6.Do you think that using technology is...?**

☐ Easy because technological devices are simple

☐ Easy because I've learned about the technology I use

☐ Difficult because technological devices are complicated

☐ Difficult because I've not learned about the technology I use

☐ Easy because technology is simple and I have learned about it

☐ Difficult because technology is complicated and I've not learned about it

☐ No idea

**Q 7.Do you think that the problem of technostress (Technology-related stress) is..?**

☐ Not serious ☐ Somewhat serious ☐ Serious ☐ Very serious ☐ No idea

**Q 8. During the LAST MONTH, Has your level of technostress....?**

☐ Decreased ☐ Not changed much ☐ Increased ☐ No idea

# Symptoms & Causes of Technostress

*It will help if in answering these questions you keep in mind technological devices such as: TV, Computer & Internet, Mobile, audio & visual devices...etc*

**Please answer the questions below by clicking/ticking a box in front of the alternatives for each question.**

**Q 9. What are the symptoms arising from stress caused by technology for you? Indicate any symptoms in each categories by clicking the box in front of the symptoms?**

**A. Physical symptoms:**

- ☐ Muscle tension
- ☐ Rapid heartbeat
- ☐ Headaches
- ☐ None of them
- ☐ Other, please specify.........................................

**B. Cognitive symptoms:**

- ☐ Mental fatigue
- ☐ Inability to concentrate
- ☐ Poor judgment
- ☐ None of them
- ☐ Other, please specify.........................................

**C. Affective symptoms:**

- ☐ Anxiety
- ☐ Depression
- ☐ Bad temper
- ☐ None of them
- ☐ Other, please specify……………………………………

**D. Behavioral symptoms:**

- ☐ Avoidance
- ☐ Withdrawal
- ☐ Insomnia (sleeplessness)
- ☐ None of them
- ☐ Other, please specify……………………………………

**E. Other, symptoms please specify……………………………………**

………………………………………………………………………………

……………………………………………………………………………………………………

**Q10. What are the main causes of technostress for you? Check by clicking/ticking a box in front of the question?**

| Cause | high | medium | low | nil |
|---|---|---|---|---|
| Information overload | | | | |
| More work required | | | | |
| New learning required | | | | |
| More demands | | | | |
| Too much change (updates) | | | | |
| Technology problems (temporary stoppages, long response times) | | | | |
| Technology physical problems (e.g. Repetitive Strain, Injuries or Overexposure to Visual Display Units (VDUs)) | | | | |
| Networking problems | | | | |
| Security issues (viruses, authentication, etc.) | | | | |
| Application software (word processors, etc.) | | | | |
| Web sites | | | | |
| Complexity (the degree of difficulty that is perceived in terms of understanding or usage of technology) | | | | |
| Multi-task (using several technological devices at the same time) | | | | |
| Compatibility 'when technology is perceived as inconsistent with existing values or past experiences' | | | | |
| Uncertainty (what happened? Did I make an error? How long will it take? What shall I do know?) | | | | |

**Other, causes please specify ........................**

**Q11. What are the solutions (in your opinion) to solve the problem of teacher's Technostress in the classroom?**

—……………………………………………………………………………………—

—……………………………………………………………………………………—

—……………………………………………………………………………………—

**Q12. How do you cope with Technostress?**

—……………………………………………………………………………………—

—……………………………………………………………………………………—

—……………………………………………………………………………………—

## Perceived Stress Scale

**Q13. These questions ask you about feelings and thoughts during the LAST MONTH. In each case, you will be asked to indicate HOW OFTEN you felt or thought a certain way. Select by ticking (√) one response for each question.**

| | not at all | almost never | sometimes | fairly often | very often |
|---|---|---|---|---|---|
| How often have you been upset because of something that happened unexpectedly? | | | | | |
| How often have you felt that you were unable to control the important things in your life? | | | | | |
| How often have you felt nervous and "stressed"? | | | | | |
| How often have you dealt successfully with irritating life hassles? | | | | | |
| How often have you felt that you were effectively coping with important changes that were occurring in your life? | | | | | |
| How often have you felt confident about your ability to handle your personal problems? | | | | | |
| How often have you felt that things were going your way? | | | | | |
| How often have you found that you could not cope with all the things that you had to do? | | | | | |
| Have you been able to control irritations in your life? | | | | | |
| How often have you felt that you were on top of things? | | | | | |
| How often have you been angered because of things that happened that were outside of your control? | | | | | |
| How often have you found yourself thinking about things that you have to accomplish? | | | | | |
| How often have you been able to control the way you spend your time? | | | | | |
| How often have you felt that difficulties were piling up so high that you could not overcome them? | | | | | |

## General health questionnaire

**Q14. In general how your health has been over the last few weeks. Select by ticking (√) the response that best applies to you.**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Have you recently been able to concentrate on what you're doing? | Better than usual | ☐ | Same as usual | ☐ | Less than usual | ☐ | Much less than usual | ☐ |
| Have you recently lost much sleep over worry? | Not at all | ☐ | no more than usual | ☐ | rather more than usual | ☐ | much more than usual | ☐ |
| Have you recently felt constantly under strain? | Not at all | ☐ | no more than usual | ☐ | rather more than usual | ☐ | much more than usual | ☐ |
| Have you recently felt you couldn't overcome your difficulties? | Not at all | ☐ | no more than usual | ☐ | rather more than usual | ☐ | much more than usual | ☐ |
| Have you recently been feeling depressed? | Not at all | ☐ | no more than usual | ☐ | rather more than usual | ☐ | much more than usual | ☐ |
| Have you recently been losing confidence in yourself? | Not at all | ☐ | no more than usual | ☐ | rather more than usual | ☐ | much more than usual | ☐ |
| Have you recently been feeling less positive about yourself? | Not at all | ☐ | no more than usual | ☐ | rather more than usual | ☐ | much more than usual | ☐ |
| Have you recently felt that you are playing a useful part in things? | More so than usual | ☐ | Same as usual | ☐ | Less than usual | ☐ | Much less than usual | ☐ |
| Have you recently felt capable of making decisions about things? | More so than usual | ☐ | Same as usual | ☐ | Less than usual | ☐ | Much less than usual | ☐ |
| Have you recently been able to enjoy your normal day to day activities? | More so than usual | ☐ | Same as usual | ☐ | Less than usual | ☐ | Much less than usual | ☐ |
| Have you recently been able to face up to your problems? | More so than usual | ☐ | Same as usual | ☐ | Less than usual | ☐ | Much less than usual | ☐ |
| Have you recently been feeling reasonably happy, all things considered? | More so than usual | ☐ | Same as usual | ☐ | Less than usual | ☐ | Much less than usual | ☐ |

## Your views

Q15. (Social statues) Select by ticking (√) the one response for each question.

| | not at all | No more than usual | rather more than usual | much more than usual |
|---|---|---|---|---|
| Are you satisfied with your friendships? | | | | |
| Are you satisfied with your primary relationship? | | | | |
| Are you satisfied with your family life? | | | | |
| Do you feel supported by your family? | | | | |
| Do you feel supported by your community? | | | | |

Q16. (Psychological distress) During the LAST MONTH, how much of the time did you feel...? Select by ticking (√) the one response for each question.

| | All of the time | Most of the time | Some of the time | A little of the time | None of the time |
|---|---|---|---|---|---|
| So sad nothing could cheer you up? | | | | | |
| Nervous? | | | | | |
| Restless or fidgety? | | | | | |
| Hopeless? | | | | | |
| That everything was an effort? | | | | | |
| Worthless? | | | | | |

**Q17. In the past 12 months, did you have any accident, injury, or poisoning that required medical attention?**

- ☐ Yes
- ☐ No

**Q18. In the past 12 months, did you have any life events that cause stress to you such as death of spouse or close friend; divorce?**

- ☐ Yes
- ☐ No

**Your details**

Q19. Gender: Male ☐ Female ☐

**Q20. Please indicate your highest level of education.......................**

**Q21. AGE: ☐ 18-25 ☐ 26-35 ☐ 36-50 ☐ 51 or older**

**Q22. What is your current marital status?**

☐ Married or Cohabiting ☐ Separated ☐ Divorced ☐ Widowed ☐ Never Married

**Q23. What kind of school you teach in?**

☐ Primary school ☐ secondary school ☐ Community Learning Centre
☐ Other please specify.......................................................

*If you wish to receive a paper report on the questionnaire's results, which address should this be sent to? ...................................

**Many thanks**